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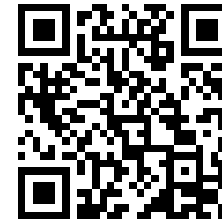

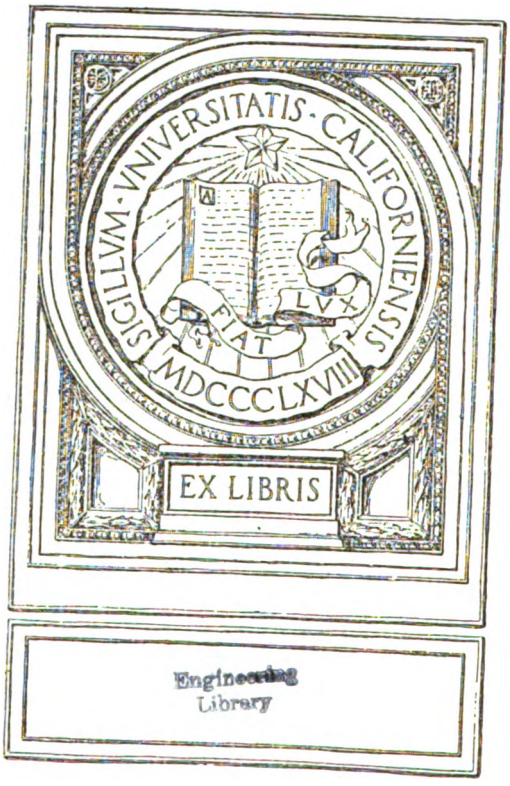


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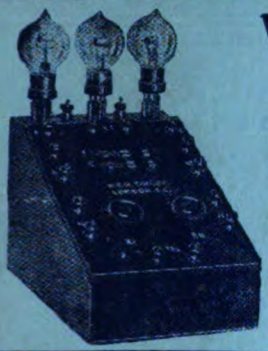

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THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
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# A Sensitive Direct Reading Voltmeter and Ammeter for High Frequencies*

By E. B. MOULLIN, M.A.

EVEN when dealing with the low frequencies of ordinary commercial power supply it is difficult to obtain a satisfactory voltmeter which can be used to measure alternating E.M.F's. as low as two or three volts, for if the instrument is either of the hot-wire or dynamometer type, the power it consumes is considerable. Hence in many cases its insertion in a circuit must appreciably disturb the conditions obtaining therein; again, should the instrument be an electrostatic one, its sensitivity is quite inadequate. But when one passes to frequencies of the order of a million periods per second, all these instruments are quite unusable; the impedance of the necessary windings of the dynamometer becomes prohibitive and the capacity of the electrostatic will be comparable with the capacities forming part of the high-frequency circuit. Hitherto, probably the only method of measuring high-frequency potential differences is by means of the "slide back" method of using a thermionic valve. This system possesses the great advantage that it uses no power, but, as will be shown below, it is as a rule incapable of measuring an E.M.F. as low as 2 V, and, moreover, except perhaps with very carefully chosen valves, it may lead to very incorrect results.

A thermionic valve, owing to its asymmetric characteristics, possesses the property of rectification: that is to say, if an alternating E.M.F. whose mean value is zero is applied to the valve, it will cause a current to flow whose mean value is not zero. The rectified current so produced may obviously be used to measure the applied E.M.F., and consequently any rectifying device can be calibrated as a voltmeter. If, then, it is possible to construct a rectifier in which the calibration is very little affected by small changes in the various conditions obtaining at the time of calibration, we have a ready means of making an instrument in which the applied alternating E.M.F. can be measured from the readings of an ordinary moving coil galvanometer.

*Received February 21st, 1922.

## Choice of Rectifier for Use as a Voltmeter.

In a thermionic triode rectification can be produced by means of the curvature of the grid voltage-anode current curve, or by the curvature of the grid current-grid voltage curve, and it is the latter method which proves most satisfactory, at any rate with an "R" triode, for the purposes of constructing a voltmeter. Even when there is no E.M.F. applied to the rectifier there will be some permanent anode current flowing, and probably also some grid current; so that in whichever circuit the indicating instrument is placed, it is necessary that the rectified current for a given applied voltage should not only be large enough to be indicated on galvanometers of reasonable sensitivity, but also it must be comparable with the current that is normally passing through the indicator. If a balance method is used this latter requirement is obviated, but for the purposes of making a convenient voltmeter with a permanent calibration it is advantageous to avoid balance adjustments.

By utilising the anode curvature of an "R" triode it is possible to obtain a rectified current of the order of 40 $\mu$A from an applied E.M.F. of 2 V, but to obtain this sensitivity as a rectifier steady grid and anode potentials must be employed such that the permanent anode current associated with them is about 1000 $\mu$A: evidently a maximum change of only 4% in the anode current cannot be accurately read without some method of balancing out the permanent deflection. But by utilising the curvature of the grid current characteristic and by causing the rectified grid current to pass through a "grid leak resistance," we can produce a reduction of mean anode current by an E.M.F. applied to the grid: this is a method of rectification familiar to those accustomed to wireless circuits, and the method of connection is shown in Fig. 1. With an "R" triode it happens that this method of rectification is much more propitious for the construction of a voltmeter, for it is possible to make an applied E.M.F. of about 3 V (R.M.S.) produce a change in anode current of as much as 40 or 50%.

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**Method of Calibrating a "Rectifier Voltmeter."**

One of the most convenient methods of calibrating is to apply the terminals of the rectifier to a potential divider of resistance form, through which an alternating current is flowing. The method of connection is shown in Fig. 1. An ordinary slide wire makes a

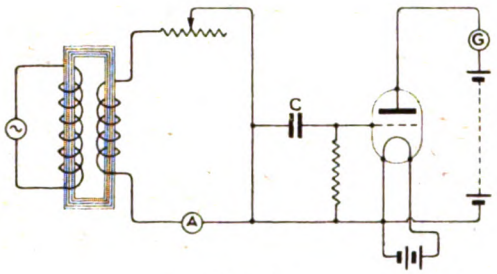


*Fig.* 1.

convenient form of potential divider, and by adjusting the current passing through it (as read by the hot-wire ammeter A) to suit the resistance of the wire, the readings of the slide can be read directly in volts (R.M.S.). The source of alternating current may conveniently be an ordinary low-frequency commercial supply, or, if it is desired to calibrate at a high frequency, a triode generator may be used. However, there is no need to doubt a calibration at low frequency, for the only part of the apparatus effected by frequency is the condenser C. If this has a capacity of about 5000 $\mu\mu$F the calibration will hold good for all frequencies: further reference to this capacity will be made later. The calibration consists in plotting the observed change in the readings of the galvanometer G, against the value of the applied E.M.F., as indicated by the slide wire.

Examples of two calibration curves (using an R triode) taken with different potentials on the anode, are shown in Fig. 2*. It is seen that if the voltage to be measured does not exceed 2·5 V (R.M.S.) the calibration curve is a straight line. These lines do not go quite through the origin, but cut the horizontal axis at about 0·1 V (R.M.S.). This is because the rectifier characteristic is a parabola if the applied voltage does not exceed about 0·2 V, and the line is really tangent to this curve at this point. The extent of the straight portions of these curves increases as the voltage applied to the anode is raised, but its steepness comes to a limiting value when the anode potential is about 100 V but the maximum percentage change in the anode current occurs when the anode potential is about 70 V. The permanent anode current associated with this potential will be about 1 mA, and consequently a galvanometer (such as a Weston student's galvo, altered so as to have a side zero) having a full scale deflection for a current of about 1 mA, will be very suitable for the indicator.

Small changes of anode potential affect the calibration less and less as the anode voltage is raised; in fact, if the anode potential is about 80 V a change of ± 4% in its value has no effect whatever on the calibration. Reference to Fig. 2 will show that even a 25% reduction only makes a 12% change in the linear part of the curve. This is a peculiarly fortunate thing, for it means that if the instrument is calibrated with, say, 80 V on the anode, there is no necessity when using it to be particular about the voltage of the anode battery differing from its nominal value by two or three volts up or down.

Experiment also shows that with this anode potential, the filament voltage can be altered between 3·6 V and 4·2 V and only alter the calibration by at most 2%. So that here again a nominal "four volt accumulator" can be used to light the valve, and what is still more important it allows us to insert a resistance in the filament so as to reduce the potential difference on the latter to 3·7 V making the life of the valve almost infinite. Even changing the resistance of the grid leak from 1·8 MΩ to 4 MΩ only alters the calibration about 4%, so that any instability in its resistance will be of no consequence. So by a set of apparently fortuitous circumstances it is possible to calibrate an instrument permanently, and make it up in a form as portable and easy of use as the ordinary moving coil voltmeter of the direct current engineer.

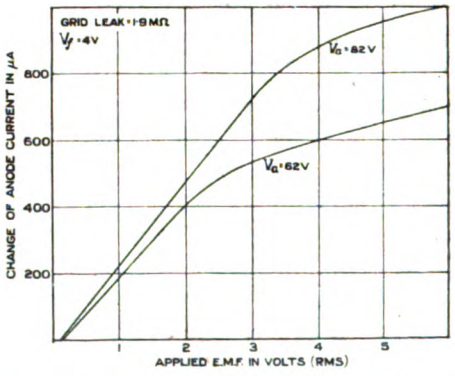


*Fig.* 2. *Calibration Curve of Rectifier Voltmeter.*

**Description of Completed Instrument.***

Figs. 3 and 4 show photographs of a completed instrument. In Fig. 3 the scale can be clearly seen, and it will be noticed that the zero of the scale of course coincides with the full galvanometer deflection. If the anode battery is slightly above or below its proper value it will, of course, cause the galvo needle to slightly under- or over-shoot the zero; but this can be adjusted by the ordinary zero adjuster of the galvanometer, for since it is the change of anode current that we are concerned with, this adjustment will not alter the calibration.

* See also paper entitled, "The Thermionic Triode as Rectifier," by E. B. Moullin and L. B. Turner, read before the Institution of Electrical Engineers, March, 1922.

* The tests were carried out and the instrument made at the Engineering Laboratory, Cambridge University.

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Fig. 4 shows the underside of the instrument, with the valve in position; the grid condenser appears to the left of the valve, and the 1·9 MΩ grid leak passing diagonally under the valve cap. The inch rule in Fig. 3 shows the scale of the instrument.

Should the valve be accidentally burnt out it is easily replaced and the instrument recalibrated; however, experiments with several R triodes by the same maker (Osram) show that the calibration depends extremely little on the particular triode. In any case the calibration is invariably linear up to 2 V (R.M.S.), and as a frequent use of such an instrument is to indicate when the voltage on part of a circuit has dropped to some assigned fraction of its original value owing to the introduction of a resistance, the absolute value of the deflection is not always important. (A small allowance for the line not going through the origin could easily be made.)

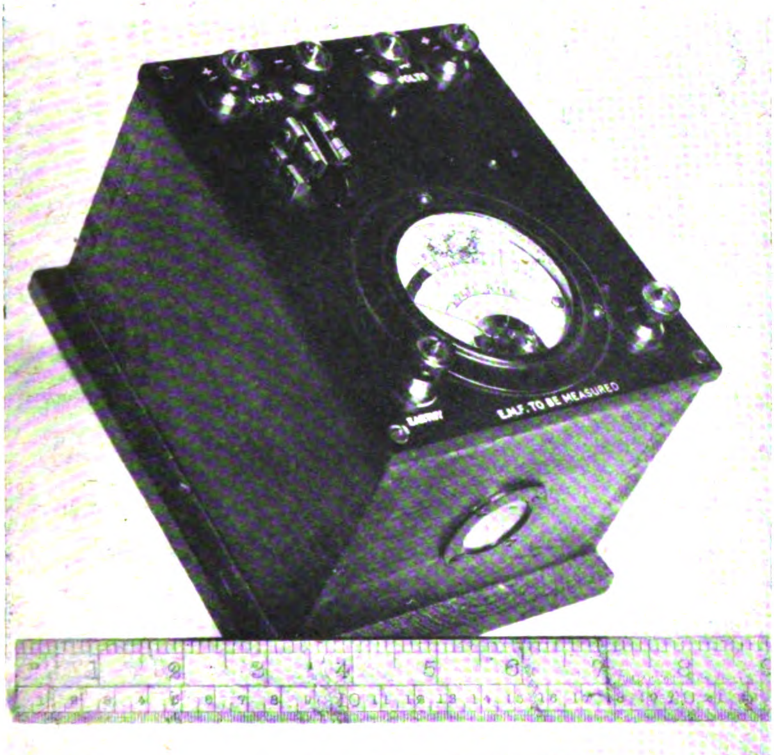


*Fig. 3. Photograph of the Complete Instrument.*

## Comparison of the Sensitivity of the Instrument with Instruments in Common Use.

The power consumed by this instrument is only a few microwatts even for an applied voltage of 6 or 7 V (R.M.S.), (the measurement of its effective resistance is considered later) and consequently it is best compared to an electrostatic voltmeter. It can be seen from Fig. 2 that 1 V (R.M.S.) can be read with considerable accuracy; it is probably fair to say that with most electrostatic instruments 40 V (R.M.S.) is the smallest voltage that could be read to the same degree of accuracy, so giving a superiority to this instrument of forty times, even on circuits of such a frequency as to make the use of an electrostatic instrument possible.

By measuring the potential developed across an inductance or capacity of known value, the current passing can be found, if the frequency is known. In this way the instrument can be used to measure high frequency currents. With the frequencies and inductances in common use in wireless this method allows us to measure extremely small currents. For example, suppose we have an inductance of 10,000 $\mu$H and a frequency of $f=10^5$, the current passing through it to produce 1 V across its terminals is about 160 $\mu$A (R.M.S.). With a vacuum-junction set of equal portability it is generally difficult to read a smaller current than about 2,000 $\mu$A, so that under these conditions this instrument has a superiority as an ammeter of about twelve times. Moreover, this instrument cannot be harmed if the voltage applied to it is excessive, whereas a sensitive thermo junction is burnt out if the current only slightly exceeds its proper value.

## Measurement of the Effective Resistance of the Voltmeter.

If the voltmeter is connected across an inductance it must introduce a small decrement into the circuit, for reference to Fig. 1 shows that current

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can flow through the grid leak, and to a smaller extent through the grid. The slope conductance of the grid is about 1 $\mu$A/V but the decrease of anode current observed with a signal of, say, 2 V (R.M.S.) indicates that the mean potential of the grid is so negative that grid current can only flow for a portion of the positive half-cycle of E.M.F.; consequently, if the grid leak is 2 MΩ, the effective resistance of the grid and leak in parallel can scarcely be less than 1 MΩ. The function of the grid condenser is to connect the grid to the alternating circuit by a path which, though impassable

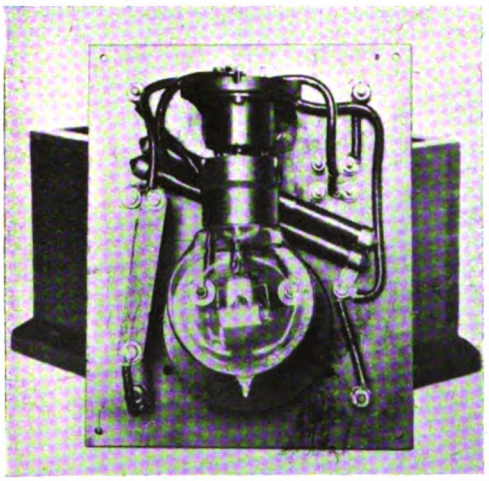

*Fig. 4. Photograph of interior of Instrument.*

to steady currents, shall present negligible impedance to the alternating current. By taking two calibration curves, one with a condenser so large as to present no appreciable impedance at the frequency of calibration, and one with a small condenser of known value, whose impedance is important, it is possible to calculate the effective resistance of the grid and leak.

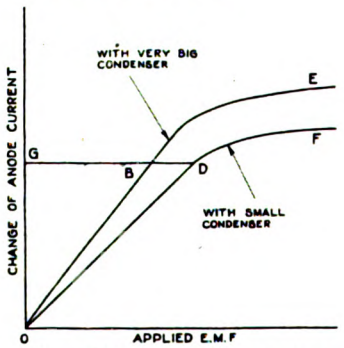


*Fig. 5. Two Calibration Curves to determine Effective Resistance of Voltmeter.*

Let the curve OBE in Fig. 5 be the calibration with a very large condenser, and the curve ODF be the calibration with a small known one. Then evidently the potential drop in the condenser is represented by BD, the potential actually applied to the grid by GB and the current through the grid condenser $= BD \times \omega C$, so that the effective resistance of the instrument must be given by $\frac{GB}{BD} \times \frac{1}{\omega C}$, where $C$ is the capacity of the grid condenser in the second case. Measurements at $f=90$; $R=1{\cdot}9$ MΩ and $C=0{\cdot}01$ $\mu$F show that up to 4 V (R.M.S.) applied to the grid GB=10 BD. Hence the resistance of the grid and leak is 1·75 MΩ, or nearly that of the leak alone; the power consumed with 4 V (R.M.S.) applied to the instrument is consequently about 10 microwatts.

Assuming that the voltmeter is across an inductance of 2,000 $\mu$H with a frequency of $f=10^5$ and that the resistance of the voltmeter is 1·75 MΩ then the decrement introduced by it would be 0·002. The decrement introduced by a vacuuo junction with a 10 Ω heater, would under similar conditions be 0·025, some ten times the amount.

### The "Slide-back" Method of Measuring Voltage.

This method of measurement is well known and was described in the *Radio Review* for June, 1921; but a short description of it will make it easier to understand the tests about to be described.

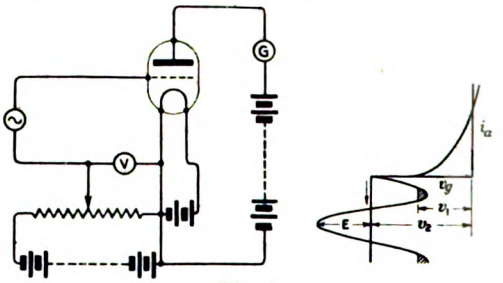


*Fig. 6.*

Let a triode be connected up as shown in Fig. 6 with an anode battery of from 20 to 40 V, and a grid potentiometer with a battery of about 30 V. When no alternating E.M.F. is being applied between the grid and the filament the grid is made more and more negative until the galvanometer in the anode circuit is just brought to zero. If an E.M.F. $e=E \sin pt$ is now introduced into the grid circuit the galvanometer will show that anode current is flowing; this is because the current produced by the positive half-cycle of E.M.F. so greatly exceeds that produced by the negative half-cycle that the result is a mean anode current of appreciable value. The current so produced can only be reduced by making the grid potential still more negative, so that anode current can flow for a portion only, instead of the whole of the positive half-cycle of E.M.F. The condition of affairs then obtaining is depicted in Fig. 6, where the mean grid potential has been reduced by an amount $(v_2-v_1)$. Anode current is now caused to flow by that portion only of the E.M.F. wave which is shown shaded.

If the grid potential is made still more negative, a condition of affairs will be reached at which anode current just ceases to flow, and when this state has been reached, it is evident that the amount by which the grid potential has been

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reduced, or the "slide back," as it is called, is exactly equal to the maximum of the applied E.M.F.

Now in the practical application of this measurement the anode current should not reach zero; for in order to be sure that the "slide back" has not *exceeded* its proper value we must still just be able to perceive an indication on the galvanometer, and the more sensitive this is, the less will be the error in taking the "slide back" as equal to the maximum of the E.M.F. At the point where the anode current becomes zero, the slope conductance of an R triode is about 6 $\mu$A/V. Let us suppose that with the galvanometer used the smallest current that can be detected is $x\mu$A. Let the area of the shaded portion of the half-cycles in Fig. 6 be $a$ volt-seconds, so that if the frequency is $n$ periods per second we must have $a \times n \times 6 = x$, or $a = x/6n$. The area $A$ of a half-wave of E.M.F. is $E/2\pi\ n$ volt-seconds, and hence $\frac{a}{A} = \frac{2\pi x}{6E} \doteq \frac{x}{E}$; consequently, the percentage error in taking the "slide back" voltage as equal to $E$, diminishes as $E$ increases.

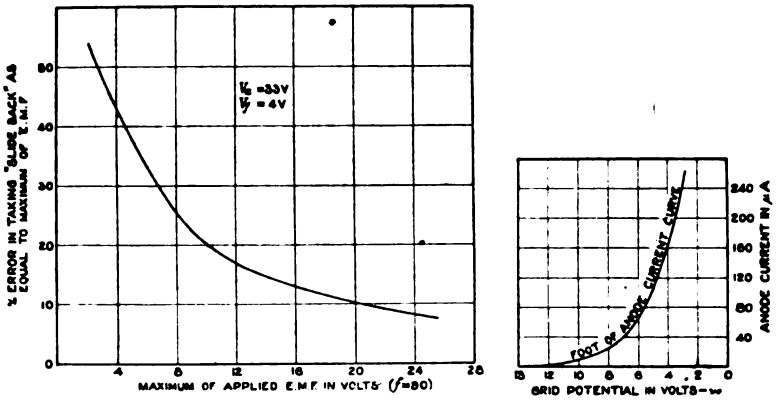
% ERROR IN TAKING "SLIDE BACK" AS EQUAL TO MAXIMUM OF E.M.F
MAXIMUM OF APPLIED E.M.F IN VOLTS (f=90)
Vg =-33V
Vf = 4V
FOOT OF ANODE CURRENT CURVE
ANODE CURRENT IN μA
GRID POTENTIAL IN VOLTS

*Fig. 7. Curves for R Triode No. 34817.*

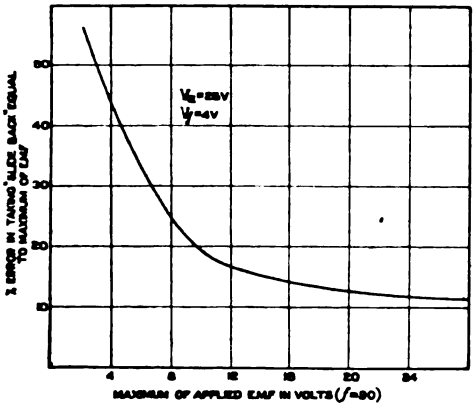


*Fig. 8. Curve for R Triode No. 34817.*

Figs. 7 and 8 show results obtained from tests of the "slide back" method, using applied E.M.F's. at $f = 90$, and inset is the foot of the anode current curves. The triode was an R pattern (Osram), and the galvanometer a 350 $\mu$A Paul unipivot: it is seen that even when $E$ is 20 V the error is still about 10%. In this particular R triode the grid extended slightly beyond the anode and completely screened the filament. Fig. 9 shows a similar curve obtained with a different specimen of R triode and using a galvanometer which would easily indicate a current of 0·02 $\mu$A. In this case an

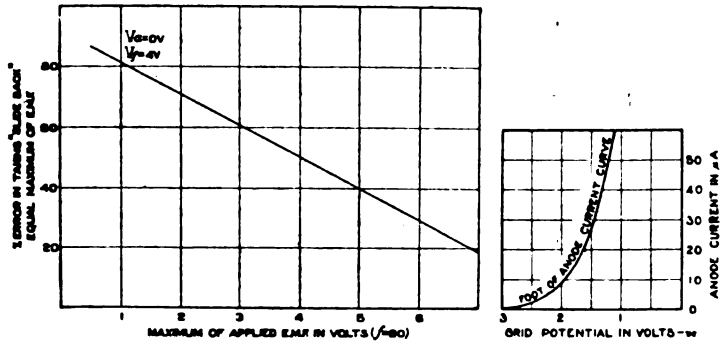
% ERROR IN TAKING "SLIDE BACK" EQUAL MAXIMUM OF E.M.F
MAXIMUM OF APPLIED E.M.F IN VOLTS (f=90)
Vg=0V
Vf=4V
FOOT OF ANODE CURRENT CURVE
ANODE CURRENT IN μA
GRID POTENTIAL IN VOLTS

*Fig. 9. Curves for R Triode . . . 93.*

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E.M.F. of 7 V maximum is sufficient to reduce the error to 10%.

By using very specially chosen triodes the "slide back" method is perhaps capable of attaining to much greater accuracy; but if ordinary valves are used, it may evidently lead to very erroneous measurements, unless the E.M.F's. to be measured are quite large.

The "rectifier voltmeter" appears to have an advantage over the "slide back" method, in that it is very much more sensitive; also, as it is calibrated experimentally, it is free from the error produced by assuming that the "slide back" voltage is equal to the maximum of the E.M.F. to be measured. It is true that the "slide back" method could also be calibrated, but it would still be open to uncertainty, owing to the personal factor in deciding when the appropriate "slide back" has been reached. The decrement introduced by the "rectifier voltmeter" is no real disadvantage, since as has been seen, it is very small and its amount can easily be measured.

In comparison with a vacuum-thermo-junction, the instrument has equal accuracy, and an advantage on the score of sensitivity; also the instrument is equally portable and easier to make direct reading. But whereas the thermo-junctions are very fragile and easily burnt out, the "rectifier voltmeter" cannot be damaged, and consequently its use must entail a great saving in the cost of upkeep of high frequency experimental apparatus.

Engineering Laboratory,
Cambridge University.

*February 18th*, 1922.

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# "The Wireless World and Radio Review"

## MESSAGES FROM MEN OF MARK IN THE RADIO WORLD

**From Senatore G. Marconi, G.C.V.O., D.Sc., LL.D., etc.**

No better proof of the growing interest of the general public in matters relating to wireless and its continuous development could be afforded than the increasing popularity of *The Wireless World*. Ten years ago this periodical started upon its career as a monthly publication, appealing only to a very limited number of students and technicians. Two years ago it began to appear fortnightly, and with the present number it joins the ranks of the widely read weeklies. Having been invited by the editor to contribute a message to the first number of the new volume, I feel I cannot do better than to congratulate him as well as the editorial staff on the great success of *The Wireless World*. At the same time it gives me great pleasure to send a personal greeting and a word of encouragement to all those who devote themselves to the study of wireless.

I hope that they will continue to find the subject as absorbing and fascinating as it still is to me.

**From Admiral of the Fleet Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S., D.Sc., LL.D., M.I.E.E., President of the Wireless Society of London; Chairman of the Radio Research Board.**

I feel sure that all those really interested in the development of radiotelegraphy and telephony will wish the publishers and staff of this new venture every success in the bold step they have taken in arranging to produce a weekly journal devoted to this important and fascinating science.

The incorporation of *The Radio Review* with *The Wireless World* indicates what a large field this magazine will have to cover, as they have, between them, included everything, from the highest mathematical physics, as applied to radiotelegraphy, to the elementary teaching of electricity to the youthful amateur and, also, the mechanical construction of the latest details of amplifiers and their adjuncts, and the latest wireless news and doings of the many clubs and societies interested in wireless, and, not least, the practical advice given to correspondents as to remedying the faults in the arrangements of their apparatus.

The popularity of the two publications is a proof that their work was efficiently done, and the retention of the editorial staff in the new venture assures that this will remain so.

The more frequent publication than formerly will also improve its facilities for the distribution of news and intelligence, and I have no doubt that the secretaries of the wireless societies and clubs will take every advantage of this to assist the editors in the preparation of their "news" sheet, which, I venture to hope, will include forthcoming as well as past events, such as wireless lectures, probable times of transmission by those holding licences, changes in times of transmission of well-known stations; in fact, a small "Stop Press" paragraph might be greatly appreciated.

I feel sure that I am voicing the opinion of the Wireless Society of London in wishing their *Official Organ* every success in its new form, and an even greater circulation in the future.

**From Dr. W. H. Eccles, A.R.C.S., M.I.E.E.**

In these modern days every group of persons possessed of a common interest or passion require an organ that shall serve as a bond of union to advance and protect mutual interests, as a means of communication, and as a platform from which the skilled may address and instruct the learners. And sooner or later, in circumstances like these, there arises an enterprising publisher who tries his luck in promoting a journal. Sometimes he receives encouraging support, sometimes his subscribers are too few, and he loses his venture. If success is indeed achieved, we may safely deduce that there is a large and keenly interested body of men study-

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ing the subject concerned and that the subject is a live and progessive one.

It is therefore with feelings of pleasure that one hears of the continually increasing success of *The Wireless World*, and that one learns that the bold venture made two years ago in converting the monthly to the fortnightly issue is now being followed up by the inauguration of a weekly issue. Evidently the lovers of wireless are already numerous and are increasing yearly. Doubtless many of them, perhaps most of them, are amateurs. Provided that the augmentation of their number does not interfere with the rights of the rest of the community in respect of wireless communications, the increase in number is a matter for national congratulation. How many hundreds of wireless students of to-day have learned nearly all they know of electricity as a consequence of the pursuit of wireless as a hobby? And since, as I believe, the future civilisation is to be predominantly electrical, is to be an epoch in which the industrial prestige and commercial standing of whole peoples will be largely determined by the wisdom with which they employ electrical methods and machinery, I feel that the perpetual dissemination of a knowledge of electricity by means of the study of wireless is a thing that all serious observers of affairs must applaud. This wholesome spreading of wireless knowledge is immensely assisted by your valuable journal, and therefore I send my best wishes for your continued useful and successful career.

**From Major J. Erskine-Murray, D.Sc., Past President of the Wireless Society of London.**

I am greatly interested to hear of the amalgamation of the *Radio Review* and *Wireless World*. The inclusion of the more technical papers of the former in the weekly publication will give your readers an opportunity of learning for themselves more of the fundamental researches on which their art is based, and at the same time will spread the scientific knowledge of the subject throughout a larger circle. I wish you every success in your venture.

**From Professor J. A. Fleming, M.A., D.Sc., F.R.S.**

I am very pleased to hear that *The Wireless World* and *The Radio Review* are to be amalgamated together into a single weekly magazine, promoting the interests of wireless telegraphy and telephony. I am sure there is a great future for such a magazine, and I wish it every prosperity and success.

**From Mr. F. Hope Jones, M.I.E.E., Chairman of the Wireless Society of London.**

The appearance of *The Wireless World* as a weekly marks an important stage in its progress, and even of radiotelegraphy in general. The tenth milestone invites Rest, Retrospect and Resolve. The Rest you are not likely to get; the Retrospect I leave to abler pens than mine, and as for your Good Resolutions, let me tell your readers that it has been my privilege to know the editors and their colleagues; that they have high ideals; that their policy is to run the paper for the good of the science, the industry and the hobby; that they will not grind individual axes nor will be influenced by commercial interests.

It is obvious that this change will greatly benefit the Wireless Society of London, and here it should be put on record that the Society is entirely satisfied with the publication of its Proceedings and the conduct of its official Journal. We have experienced invariable courtesy and material assistance.

*The Wireless World* has recently been open to the criticism that too large a proportion of its pages has been devoted to mere records of meetings of wireless societies. As one who is always reported in full, it would ill become me to complain of this; but I have often sympathised with your readers, and I am glad to think that the incorporation of *The Radio Review* will now redress the balance.

There is one gap which you will now be able to fill properly. There is a real need for prompt intimation of changes and additions to the programmes of regular transmission services. As an instance of this, I may mention that many beginners are still fumbling for time signals among the sidereal rhythmics at 10 a.m., in spite of the recent republication of your big list. It is your duty and privilege to publish the only Wireless Time Table. Keep it up to date, preferably by a weekly Bulletin, always to be found on the same page.

Thanks to the improved conditions which we are fighting for and are confident of obtaining, the present number of licences will, in my opinion, be doubled in quite a short time. *The Wireless World* should be indispensable to all licencees and your future prosperity is assured.

**From Sir Oliver Lodge, F.R.S., D.Sc., etc.**

Everything which tends to reduce the number of periodicals and increase their scope, is to the good.

Amateur enterprise in this country is deserving of encouragement, as is already done in America. Combined effort will advance the subject, and amateurs with no professional duties which forbid experiment have every chance of introducing improvements.

**From Captain F. G. Loring, R.N., M.I.E.E., Inspector of Wireless Telegraphy, General Post Office.**

In reply to your request for a personal message to your readers on the occasion of the first appearance of *The Wireless World* as a weekly publication, and at the same time of the incorporation of *The Radio Review* with it.

It gives me great pleasure to testify to the interest and usefulness of those two periodicals, and as a reader of both I welcome their combination as a matter of convenience and economy. The particular interest of *The Wireless World* for me lies perhaps in the fact that it is the official organ of The Wireless Society of London and its affiliated Provincial Societies. As a result *The Wireless World* becomes the mouthpiece of the British experimental and amateur wireless movement. No one may deny the important part played by the so-called "amateur" in the development of science and art and every *bona fide* wireless experimenter should receive all the encouragement it is possible to give him, provided that in return he will but master the rules and observe the regulations which admit him to the Freemasonry of the ether.

I have been greatly interested in the recent experiments with American amateurs, and take leave to congratulate both British and American amateurs on the results obtained. The important



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point to my mind is the fact that they were accomplished as part of a programme. Unexpected freak ranges at night of hundreds and even thousands of miles on short waves with small power have always been common knowledge.

I have a distinct recollection that as far back as 1901 or 1902 the Marconi Company reported that one of their ships, using a 10-inch induction coil on "Tune A" (360 feet wave), sent out signals which were received by another ship over 1,000 miles away on a filings coherer and were recorded on a tape machine. No doubt in those days such a wonderful result had its influence on the policy of the Company in regard to the erection of stations for Transatlantic communication. Good signals at 1,000 miles on ½ kilowatt under special conditions was not, however, the precursor of good signals at 2,000 miles on 100 kilowatts at all times. Since those days the study of very short waves on low power has been rather neglected until quite recently, when their marvellous range under certain conditions has been rediscovered and communication established during a predetermined period over a distance of 3,000 miles and more. Whether there has been any real advance towards the use of such waves for regular long-distance communication, is not yet evident. I suggest that the investigation of very short wave wireless transmission and reception is a field of investigation peculiarly suitable to the members of wireless societies who must always be under considerable restrictions in regard to the power which they are permitted to employ in their experiments. I shall hope to read in due course that it has become possible for British and American amateurs to exchange signals on 180 metres, not accidentally nor even during a predetermined period, but at a predetermined moment of the year. I wish I felt as confident of the accomplishment of this result as I am that if and when it is accomplished the Postmaster-General will take steps to see that there shall be no infringement of his monopoly!

Wishing *The Wireless World* and *The Radio Review* the best of circulations in their combined form.

### From Lt.-General Sir Robert Baden-Powell, Kt., K.C.V.O., K.C.B.

I am delighted to see that the demand for *The Wireless World* has rendered necessary its issue as a weekly journal.

This step "wirelesses" to the world the inspiring fact, which I have also realised for myself among the Boy Scouts, that the students and users of the science are growing greatly in numbers and keenness.

Thus there lies before us the promise of wonderful developments and inventions in the near future, where so many pioneers are devoting not only brain and resourcefulness but heart as well to the fascinating subject.

### From Mr. A. A. Campbell Swinton, F.R.S., etc., Past President of the Wireless Society of London.

I am sure that all readers of *The Wireless World* and, indeed, all those interested in wireless telegraphy, will be very much pleased to hear the announcement that *The Wireless World* is in future to be published weekly instead of fortnightly, and is to include a section comprising the class of matter that has hitherto been published monthly in *The Radio Review*.

I know of no new pursuit of a scientific character which in recent years has aroused so much general interest as has Wireless Telegraphy. Indeed, there has been nothing like it since the early days of motoring, and, before then, since the days of the invention of the telephone and microphone. As such interest is likely to increase rather than diminish, I foretell an increased circulation for *The Wireless World* in its new form. I am sure the Wireless Society of London did a very good stroke of business when they arranged for *The Wireless World* to become their official organ and to publish all their papers.

Wishing *The Wireless World* all success.

### From General G. Ferrié, C.M.G., LL.D., Inspector-General of French Military Telegraphs.

La télégraphie sans fil constitue à l'heure actuelle le plus parfait moyen de diffusion rapide de la pensée humaine. Son développement ne peut donc que contribuer à accroître la concorde dans le monde, car les peuples se connaîtront mieux grâce à elle. De plus, ses applications scientifiques dans divers domaines prennent une importance sans cesse croissante.

Il est donc très utile d'accroître de plus en plus le nombre de personnes qui sont au courant des progrés et des applications de la T.S.F., et de leur donner les indications necessaires pour qu'elles puissent utiliser ces progrés pour leur usage personnel.

L'extension de votre intéressant publication contribuera à atteindre ce but. Je suis donc convaincu qu'elle est appelée à un grand succés.

(TRANSLATION).

*Wireless telegraphy constitutes at the present time the most perfect medium for the diffusion of human thought. Its development, therefore, cannot but contribute to the establishment of goodwill in the world, for, thanks to it, the nations are able to know each other better. Moreover, the scientific applications of wireless telegraphy in its various aspects are of ever-growing importance.*

*It is therefore useful to increase more and more the number of persons conversant with the progress and applications of wireless telegraphy and to give them the advice necessary to enable them to utilise this progress for their personal needs.*

*The expansion of your interesting publication will assist in the attainment of this end. I am therefore confident that a great success awaits it.*

### From Dr. Pierre Corret, Editor of La T.S.F. Moderne, Vice-President of La Société Française d'Etude de Télégraphie et de Téléphonie sans fil. From the French Amateurs to the British Amateurs.

At the moment when your excellent gazette, *The Wireless World*, attains the status of a weekly, and thus bears witness to the brilliant state of wireless amateurism in Britain, we, French amateurs, wish to greet and congratulate you, our unknown friends, across the Channel.

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In advance of us, and guided by leaders more expert, you set out on the path of wireless experiment. Amateurs well grounded in theory and skilful in practice are more numerous with you than with us. You have a larger number of societies and the subjects with which they deal are more scientific. We look forward eagerly to the day when we shall have, in our societies, meetings as interesting as in yours, particularly in your WIRELESS SOCIETY OF LONDON. Also your valued organ, *The Wireless World*, we keenly envy, not only for its frequent and punctual appearance, the number of its pages and the diversity of its subjects, but principally for its highly interesting character and for the skilful manner in which it is conducted by its clever editors.

As is shown by the present state of our *Société Française d'Etude de Télégraphie et de Téléphonie sans Fil*, of our not yet very numerous provincial societies, and of our modest organ, *La T.S.F. Moderne*, we are at the present time as it were your younger brethren, who are very desirous of following your example and that of your still older cousins of the United States. With joy we applauded your brilliant success in the Transatlantic Tests, having here only one amateur who received only partially the American signals; and now we shall, doubtless, be able soon to set to work with you.

As you, of course, know we recently received from our somewhat dilatory postal administration a transmitting licence, which we had not even applied for; we had experienced such difficulties with the administration with regard to reception merely that we had not ventured even to think of the possibility of transmission.

This licence was not intended in principle for us amateurs, but in a general way for experimental and testing stations. However, we were, of course, very glad to seize the opportunity promptly and to receive legal permission for our tests and experiments also.

Owing to its not specially amateur character, our present transmitting licence is of a somewhat peculiar nature. Theoretically, there is no limit to usable power, nor to wavelength. Permission is obtainable even for a station with 100-kilowatt power and any wavelength whatever, but will be granted by the postal administration on condition only that the motives given for the establishment of the station seem sufficiently justified. However, if the power does not exceed 100 watts, nor the wavelength 200 metres, it is not necessary to state motives in the application for a licence. Hence we may say, though this is not absolutely precise, that for amateurs the limits are 100 watts and 200 metres.

It had not been laid down, whether the 100 watts is *input* or *output* power. In order to obtain a definition. *La T.S.F. Moderne* applied for permission, without statement of motives, for a station with a maximum of 100 watts in the aerial and a maximum wavelength of 200 metres—and received it.

The annual charge is 100 francs for each kilowatt or part thereof, hence for amateurs 100 francs. Only scientific research and tests of apparatus are allowed, but not correspondence on personal and contemporary affairs. If private and contemporary correspondence with any other station be desired a special licence must be obtained and an additional charge of 45 francs for each kilometre between the two stations is levied. If more than two stations wish to correspond there must be a further payment of 45 francs for each corresponding station beyond the first two.

In conformity with these arrangements *La T.S.F. Moderne* has applied for a licence for private and contemporary correspondence with one receiving station, whose owner wishes to receive promptly information of all kinds on radio telegraphy, hours of transmission from large stations, etc.

Such is a summary of the conditions under which we French amateurs can now receive a transmitting licence. We hope that ere long we shall be able to carry out tests and experiments with you, our British friends. Still, some considerable time must certainly pass before that can be achieved, for hitherto we in France have had very little experience and practice in short waves, and we have need of learning something in this branch, which is not of the easiest.

Still another difficulty we foresee, namely, the barrier of language. What language shall be used by British and French amateurs, who do not know each other's national tongue? What will be the use of words reaching us from across the Channel, if we do not understand them? This difficulty has already been made clearly evident to you in the announcement, in French, of the names of items in the Telephonic Concerts from the Eiffel Tower. Happily a simple solution exists: we shall be able to use the very easily acquired international language, Esperanto.*

Possibly you wonder that I, a Frenchman, write so well in English; yet I do not know your language at all. I can to some extent guess at its meaning when reading it, but I am quite unable to write it. This friendly message I have written to you in Esperanto without difficulty, and its text has been translated into English by a British Esperantist. I am absolutely certain that he has transmitted my thoughts to you far more accurately than could have been done by a Frenchman with a "good knowledge" of English, or by an Englishman with a "good knowledge" of French.

As a preliminary test in this direction, *La T.S.F. Moderne* will use Esperanto for items of general information transmitted to its private correspondent.

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The Editor wishes to thank all those who have written to express appreciation of the introduction of the weekly publication of *The Wireless World* and the incorporation of *The Radio Review*.

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* All information on the subject may be obtained from the British Esperanto Association, 17, Hart Street, London, W.C.1.



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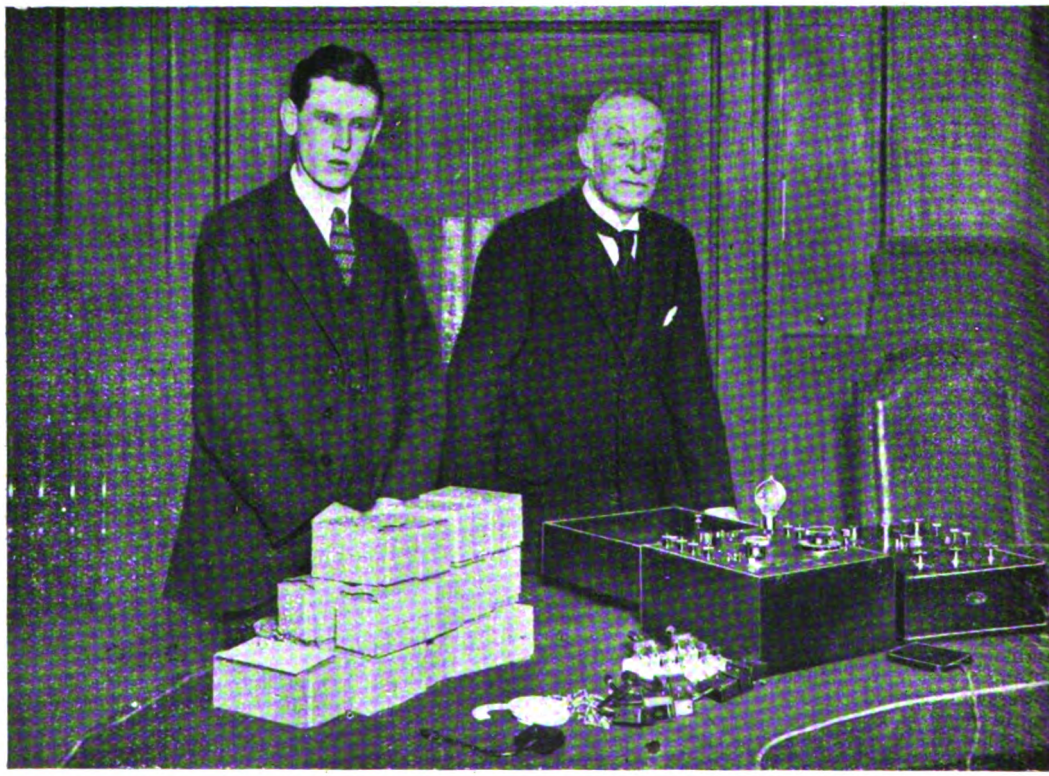
# Presentation of Prizes to the First Prize Winner in the Transatlantic Amateur Tests.

AT the meeting of the Wireless Society of London, held at the Institution of Electrical Engineers, Victoria Embankment, on Tuesday, February 28th, a presentation of prizes gained by Mr. W. R. Burne, first prize winner in the Trans-Atlantic Amateur Tests, was made.

Mr. W. R. Burne had been invited to London from Manchester for the occasion by the Wireless Society of London, and in receiving the prizes at the hands of the President he represented also those other successful competitors in the Tests who had gained Second and Third Prizes. Addressing the meeting, the PRESIDENT said :—

The next business is a very pleasant one indeed, and that is to present the prizes to the successful competitors in the Transatlantic Radiotelegraphic Communication Tests in December. Mr. Coursey is going to give a brief description of the work done by the successful receiver, so that I will not take up the time of the meeting, except to say that I feel we ought to be very grateful to the firms who have encouraged this work by their very generous offers of these prizes, some of which are on the table here. Only one successful member is present to-night, and I think that all the apparatus on the table and something that I have in my pocket, presented by Messrs. G. Z. Auckland & Son, has been won by him. But we are really congratulating all the successful competitors, eight in all, and their prizes either have been or will be sent to them in due course. I will ask Mr. Coursey to give a short description of the Tests. (*Applause.*)



*The Presentation to Mr. W. R. Burne.* [*Photopress.*

MR. P. R. COURSEY.

I have been asked to say two or three words this evening on the subject of these American short wave tests, which were carried out in December last. Probably many of the audience here this evening remember Mr. Godley's visit to this country and his attendance at one of the meetings of this Society, when he told us about the American Radio Relay League, which is one of the largest amateur organisations in the United States.

The first organised Transatlantic Test was made in February, 1921. It lasted three days only with one blank day in between the Tests. Nothing definite, however, was received on this side, and a

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considerable amount of disappointment was in consequence felt both in this country and in America. These negative results were due not so much to any failure on the part of either the transmitting stations in America, or of the receiving stations on this side, but to the fact that the tests lasted for too short a period for definite communication to be established in view of the very variable atmospheric conditions.

The second test took place between the 7th and 17th of December last, and lasted for ten successive days or, rather, nights. There was, therefore, much more chance of signals being heard, and we can now say that American amateurs certainly got into communication with amateurs in this country using comparatively small apparatus, as compared with the high-power transatlantic stations. The chief point of interest in the Tests lies in the short wavelengths employed, most of them being round about 200 metres, but some going up to 360 or 375 metres. The bulk of the stations worked on round about 200 metres.

Before the tests were carried out opinion in America was very divided as to whether spark or C.W. stations would come out best. I think in this country we had very little hesitation in saying which we thought would be the best. But very good results had been obtained in America with spark sets having an input of 1kW, and these led them to expect that quite good results might be obtained from their spark transmitters. This in a sense proved to be the case, as signals from spark stations were heard by Mr. Godley at Ardrossan, Scotland, but no definite signals from spark stations were heard by the British listeners. Mr. Godley's reception results showed that although he heard some spark signals, he heard far more C.W. stations. I think this conclusively proved, if such proof were needed, that C.W. transmission is undoubtedly more effective than spark over long distances for the same power.

The scientific interest of the tests lies in the accomplishment of radio communication, including the reception of at least one complete message over such a long distance with such short wavelengths and such small power. Some somewhat misleading statements have been made as to the possibility of the value of such signals; but it is quite obvious that to secure commercial transmission over such a range requires much larger power in order to secure regular communication, not only every night, but every day as well. These Tests showed that the signals came over very much better on about two nights than they did for the remainder of the period. The transmission qualities over the Atlantic during the period rose to a maximum after about three or four days, and then fell off to zero, and practically nothing more was heard

I think it would be of interest to point out here that the British entrants made greater use of high-frequency magnification than did the Americans. The first four of the most successful of our amateurs on this side all used high-frequency magnification on the short wavelengths. Mr. Godley brought apparatus with him which was typical of the best American practice that they had evolved for long distance short wave reception, and he did not have any high-frequency magnification in front of his first detector valve. He used the Armstrong super-heterodyne principle, in which the incoming signals are heterodyned before the first detector valve. That scheme has been used in this country, and one listener at least, I know, obtained very good results with it; but in broad outline the successful receivers followed the same general scheme—one, two or three, or even four or five, high-frequency stages with tuned anode coupling between the valves, followed by a detector valve and possibly one or two stages of low-frequency amplification. The best reception as regards the number of stations heard was made by Mr. W. R. Burne, of Sale, Cheshire, who intercepted signals from seven American stations. Three for certain of these were received correctly, with the code words which were allotted to these stations, as a means of definitely verifying the reception. Others were not doing individual test transmission work, and had therefore no definite code signals, but were heard during a "free for all" period, and the remaining one was a special C.W. station put up by a group of American amateurs using practically the full licensed power of 1 kW input. The signals from that station were certainly very much more powerful than heard from any other United States station, and it has subsequently transpired that the other C.W. stations that were heard were using much less power than 1 kW.

The next best reception was made by Mr. Whitfield, of Birmingham. He received three stations—**1BCG**, the above-mentioned special station, and two others with complete code words. For the next best reception two have been put together. They are Mr. Corsham, of Willesden, and Mr. Spence, of Huntly, Aberdeenshire. Each of these received one station with the correct code group. Others who received signals were Mr. A. E. Greenslade and Mr. E. McT. Reece, of Clapham, who made a very prolonged reception of **1BCG**; Mr. T. Cutler, of Southampton, Mr. J. R. Forshaw, of Liverpool, and another one in the South of England, who does not wish his name to be divulged.

The American set used by Mr. Godley contained in all ten valves—two oscillators and the remaining ones detecting and amplifying. As a comparison to this there was one British amateur who heard signals from **1BCG**, and used two valves and a crystal detector. It is, I think, extremely creditable that signals should have been heard on such simple apparatus. Others used up to four or five stages of high-frequency amplification.

Another interesting point might be mentioned with regard to the comparison between the times at which signals were heard by Mr. Godley and by the British workers. On the morning of the 8th Mr. Godley reported hearing a station **1AAW**. That has not been verified, as it has been proved since that that station was not sending, so it seems that somebody was using a false call. On the morning of the 9th he reported no signals. On the morning of the 10th he heard **1BCG**, the special transmitting station. On the morning of the 11th he heard the greatest number of signals; he reported fifteen stations that morning, that is on the first Sunday morning during the Tests. As against Godley's first definite reception, reported on the morning of the 10th, we have that of Burne, who heard four stations on the morning of the 8th December

As regards the methods of valve amplification on

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this side, we were probably in advance of Mr. Godley in that respect. We do not come up to him with regard to the number of stations heard, but when taking into consideration the fact that at the beginning of the Tests he used an aerial 1,350 ft. long, and afterwards cut that down to 850 ft., whereas all the British people had not more than the Post Office aerial of 140 ft., it does not seem surprising that he should hear more signals. In fact, I think it is all the more creditable to the British workers that they heard any at all, and, taking into account the difference in the aerial sizes, our results show not at all badly as compared with Mr. Godley's. He also heard signals on the morning of the 12th; but on the 13th, 14th, 15th and 16th he reported no signals. As against that we certainly have several signals on the 8th; we have one on the 10th, we have several on the 11th, and we have one on the 14th, so that again in two cases we may say we were hearing signals when he did not do so. A receiving station in the South of France also heard signals towards the end of the Test when Mr. Godley reported nothing.

It is also interesting to note that the United States station **2ZL** owned by Mr. J. O. Smith, of Long Island, was heard by the first three British prize-winners, but was not heard at all by Mr. Godley at Ardrossan.

I will only detain you a little longer to mention the fact that a number of prizes, as already stated by our President, were offered by wireless firms in this country to those who made the best reception, and two or three prizes were offered in some cases. Some of the prizes carried conditions attached to them to the effect that they would not be awarded unless the successful amateur used apparatus supplied by these firms, and that has cut out the award of a few prizes. But the remainder, as already announced in *The Wireless World*, have been allocated. Several of the instruments are here on the table, but one or two remain to be chosen by Mr. Burne, who has been offered the choice of apparatus to the value of the prize. Well, I do not think I need detain you any longer in discussing this matter. The Tests have been successful, and it is hoped that before long further definite communications may be established and possibly also in the course of time regular working between the amateurs of the two countries. (*Applause*).

THE PRESIDENT.

Mr. Burne is present in person as a guest of the Wireless Society this evening, and I think we will ask him to represent all the other successful competitors; and I should like to ask him to come to the table to hand him a cheque which, as has been stated, I have in my pocket, and let that represent my presentation to him and to the other successful competitors. I should like to tender to them my personal congratulations on the successful completion of the Test. (*Applause*). I think we must also thank Mr. Coursey for his very lucid description of what happened; I think we ought to thank those in America who sent the messages through for this most interesting and instructive competition. I hope that we will repeat it again next year with even better results.

MR. W. R. BURNE.

May I just say a few words, as I have come up to London from Manchester, and am expected to represent all the successful people. I would like to thank you very, very much indeed for the splendid way in which you have dealt with me in inviting me up to London to receive these prizes. I assure you it is a great thing for me, as I have not been in London before. What is more, I was hoping it would be wet. People who come to Manchester from London say Manchester is always wet, and those who come from Manchester to London say in London it is always raining. I was hoping it would be wet, so that I could say the same. However, I am very glad it did not rain, because of it being Princess Mary's wedding day: it would not have been at all nice.

With regard to further tests across the Atlantic, I have got into communication with Mr. J. O. Smith (**2ZL**), Mr. Estey (**1AFV**) and others, who very kindly sent again to a few of us who listened. Mr. Corsham, Mr. Whitfield and myself listened until about 2.30 a.m. from the beginning of this month, and I cannot say that the tests have been altogether successful; but I think that one station was heard one night by Mr. Whitfield and myself. On another morning at 2.15 a.m. a station was undoubtedly heard by myself. I do not know whether the others heard it. To-day I had a letter from Mr. J. O. Smith, of Long Island, saying he was very keen on further tests, and saying that he would be sending every night at 8 o'clock, New York time (*i.e.*, at 1 o'clock a.m. G.M.T.) calling **2KW**, and if anybody else would like to listen for him I shall be pleased to hear from you.

I think it is a great thing, this Transatlantic signalling, and I am only sorry that I did not do better. Having had an accident I was not able to rig up my apparatus until the morning of the Tests. Everything was so hurried that I could not possibly do better really, but I am very, very pleased that other Britishers besides myself have been successful, and I hope it will not be the first or second time, or anything like that, but that we will be able to get into communication with the American people, and not only receive their signals, but send to them as well, if only the Post Office could be persuaded to grant us licences for short wave work. (*Applause.*)

## French Amateur Transmitting Stations.

The French amateurs are taking full advantage of their recently granted facilities for experimental wireless transmissions. We learn that some ten stations have already been licensed and we are able to publish the calls of the first of these, which are as follows:—**8AB**, **8AD**, **8AE** and **TSFM** (the station of *La T.S.F. Moderne*), and **8AH**.

The station **8AB** belongs to Mr. Léon Deloy, of Nice. We understand that this station which has already begun to transmit has been heard in London. We shall be glad to receive reports of the reception of any of these stations or any other stations bearing the distinguishing figure eight, which it appears is to be allotted to the French experimental stations.

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# A Tuner and Three-Valve Amplifier for all Wavelengths*

By Percy W. Harris.

A FEW months ago the writer of this article was faced with the problem of how best to design and erect a receiving station of high efficiency and low cost, to comply with the following conditions :—

(1) The installation to be suitable for the reception of all wavelengths from 300 metres to 23,450 metres (Bordeaux).

(2) To be sufficiently sensitive to give good readable signals from the chief American high-power stations on a standard amateur aerial.

(3) The constructional work to be performed without a workshop or lathe and with a few ordinary tools, from well-made component parts, readily procurable from the dealers.

(4) The total cost, including aerial, mast, insulators, tuner, amplifier, valves, batteries and telephones, not to exceed about twenty-five pounds.

In due course the problem was solved, and it is thought that a complete description of the installation and the manner in which it was made will be of some interest to those amateurs who lack workshop facilities and experience in making wireless gear. As will be seen, the installation is such that any intelligent amateur can construct most of it by the fireside.

* This apparatus was demonstrated and briefly described at the Meeting of the Wireless Society of London, on December 28th last. See *The Wireless World* for January 21st, page 643.

### Aerial and Earth.

Having obtained the necessary permit from the Post Office, the construction of the aerial was first undertaken. The writer is no believer in high aerials for reception, for this reason it was decided to make the aerial from 50 to 60 feet in length and 20 feet in height, with twin wires six feet apart, a twenty-foot down-lead at one end being taken to the house. Actually it is slightly under 60 feet in length, owing to the fact that, with the twin down-lead, the permitted 140 feet of wire is not exceeded.

For the mast, a 20-foot aeroplane spar was purchased (from one of the dealers advertising in this paper, at a cost of 16s., delivered). This was secured to the back of a shed at the end of the garden (see Fig. 1) Owing to the fact that the spar is fairly rigid and supported against the shed for eight feet or so from the ground, no guy ropes were required. To the top of the mast a small pulley block (1s. 6d.) was tied, and a rope, 30 feet long (ordinary clothes-line), run through it and the two ends tied together. This double rope thus hung down within easy reach for hauling purposes. A six-foot ash spreader (3s. 6d.) was then purchased from the dealers, together with five of the well-known green porcelain "shell" insulators at 1s. 8d. each, and a 150-foot roll of 7/22 phosphor bronze aerial wire (13s. 6d.). The spreader was laid on the ground, a short length of rope secured to each end to form a bridle, and this rope fastened at its middle point to the 30-foot rope already mentioned. Two of the "shell" insulators

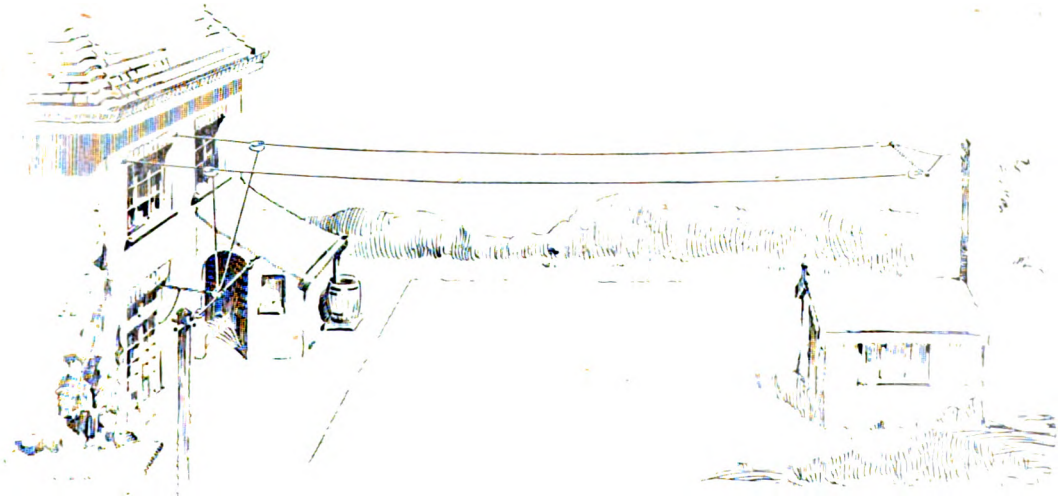

*Fig. 1.—It is a mistake to think that high aerials are necessary for long distance reception. The aerial described in this article is only 20 feet high and, as shown in the sketch, is of modest proportions. The total length of wire is 140 feet. The free end is due south.*

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were then tied to the spreader with strong cord (one at each end), and the aerial wire unrolled down the garden and cut into two equal lengths. Two

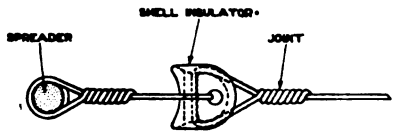


*Fig. 2. Method of attaching Aerial Wire to Insulator, and Insulator, to Spreader.*

of the ends of wire were then passed through the insulators, the strands separated and twisted round the wire to form a secure joint (see Figs. 2 and 3). At the house end, two large hooks were screwed into the frame above the upstairs windows, 20 feet from the ground and six feet apart. To these hooks short lengths of rope were fastened and at their ends two more shell insulators, through which the two aerial wires were passed. The down-leads were then brought down and together passed through a further shell insulator, which had previously been threaded on a transverse rope, supported between a short pole and a hook on an outhouse. The dining-room window frame was drilled to take the wire, which was then passed through the hole and finished with a terminal inside the window-frame. To prevent water entering, the hole was filled with Chatterton's Compound. The general arrangement will be seen from Fig. 1. An important point, and one which contributes to the efficiency of the aerial, is that the down-lead is held well away from the house. No leading in insulator is used—the wood of the window-frame sufficing. (Fig. 4.)

Fortunately, the rising pipe from the water-main is situated in the kitchen immediately adjoining, so that a very short lead, taken through a hole in the wall inside a cupboard, (a hole luckily made previously by workmen to take a gaspipe), formed the earth connection. One end of the earth-lead finishes in a terminal in the woodwork of the cupboard and the other in a strip of tinned copper, clamped to the pipe in the kitchen (see Fig. 4).

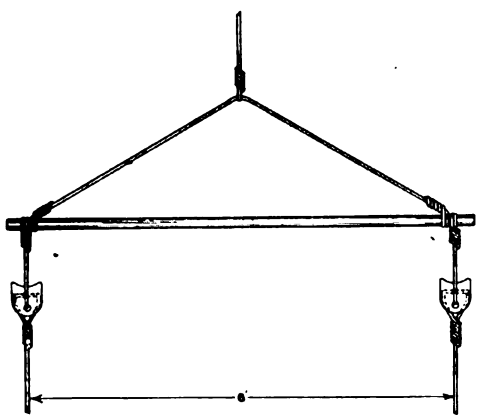

*Fig. 3. Method of attaching Spreader to Rope.*

### The Tuner.

Having purchased a Mark III* tuner and a pair of 4,000 ohm Brown's telephones, the internal connections were altered slightly, as described by Mr. Philip R. Coursey in this magazine (5th and 19th March, 1921), so that additional inductances could be inserted in the primary and secondary circuits, and the aerial condenser placed in parallel, as well as in series, with the A.T.I. For preliminary experiments, an inductance was wound on a cardboard former, 8 inches in diameter and about the same length, tappings being taken off every few turns, and very thorough tests undertaken with the aerial and tuner. Using the perikon detector, it was possible to read North Foreland, Niton, Cherbourg, Havre, Ostend, Cullercoats, Land's End, Norddeich, Poldhu, Paris and many others, including on a few

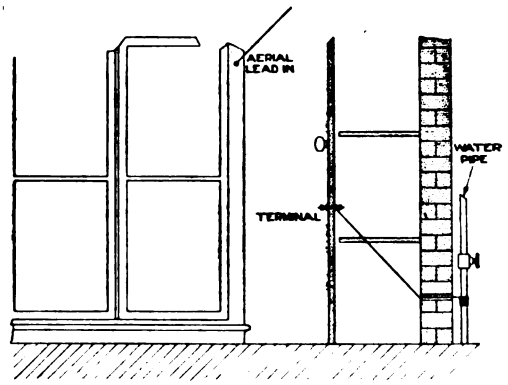


*Fig. 4.—The aerial is led in through a hole drilled in the window frame. No leading in insulator is used. On the right is shown the terminal for the earth lead. It is fixed in the woodwork of a cupboard.*

occasions even St. Maries de la Mer and Cadiz, while ships, of course, were always audible.

After these preliminary experiments were over, the complete station was designed. It was to consist of a three-valve amplifier, with reaction, one valve to be for high-frequency amplification, one for detecting and one for note magnification. As no workshop facilities and very few tools were available, it was necessary that everything should be put together from purchased components, easily obtainable from the dealers.

### Circuit.

The circuit decided upon is shown in its simplest conventional form in Fig. 5. The portion marked A, is comprised within the Mark III tuner, on to the back of which was mounted a three-coil holder to take the well-known Duolateral, Honeycomb or Burndept coils, one coil being for aerial circuit, one for secondary and one for reaction. The portion B is all contained within a second Mark III tuner case, from which all of the original parts had been removed. These empty cases can be obtained for

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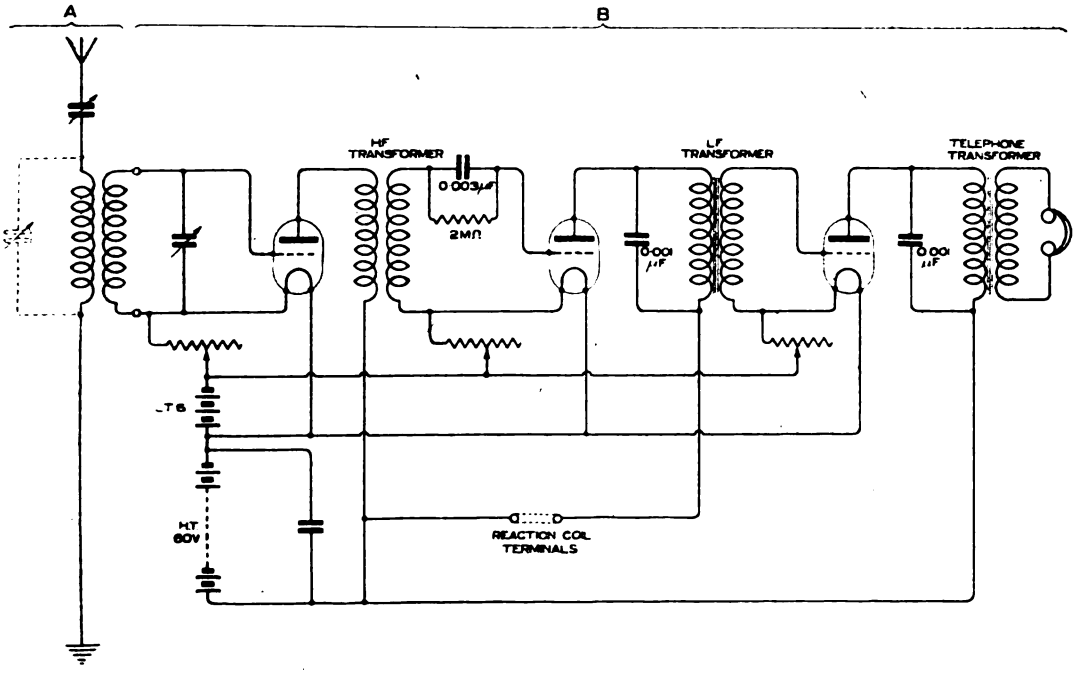


*Fig. 5.—Simplified diagram of connections. It will be noticed that the H.T. battery is joined to the + terminal of the L.T. battery, in which way the 6 volts of the L.T. are added to the H.T. No grid potentiometers are used.*

a few shillings, and being very strongly made of solid mahogany, are particularly suitable for assembling wireless apparatus. In addition, the lid is of great value in keeping the instrument free from dust.

There are many occasions when three valves give far too strong signals, and when one is ample for the purpose. Further, it is useful to be able to compare one, two and three valves on certain signals, and to try the relative merits of a high-frequency valve with detector, against a detector with a note magnifier. It was, therefore, decided to add switches to the set to allow of a rapid change over to various combinations. After much consideration, the circuit was elaborated so that with the aid of four switches, any arrangement of valves could be obtained, and on the last valve high or low resistance 'phones used, according to whether a telephone transformer be switched in or out. Figs. 6 to 9 show how the switches are used.

It will be seen from Fig. 5 that the valves are transformer-coupled for both high and low frequency. Transformer coupling was chosen so as to obtain the highest efficiency, although resistance-capacity coupling would have been cheaper to buy. It must be remembered, however, that resistance-capacity coupling in high-frequency amplification is not suitable for shorter wavelengths. For high-frequency amplification, the new Sullivan H.F. transformer was purchased (this has a four-point switch for 200-400, 400-1,000, 1,000-3,000 and over 3,000 metres), and for low-frequency the "Federal" transformer. Both have answered all expectations, and indeed, exceeded them. The grid leak and condenser are of the combined pattern, the values being ·0003 microfarads and two megohms.

The change-over switches are of the well-known American battery type, demounted from the porcelain bases. The telephone transformer is of the well-known Army type (valve to 'phone).

The method of assembly was quite simple. First of all, the wooden partition of the empty Mark III case was removed and the ledge on which the ebonite top rests continued right round the edge. From one of the dealers a sheet of new ebonite, 5/16ths thick, was obtained and fitted by the dealer to the exact size of the top. When cut it weighed exactly two pounds, and cost about 15s. or 16s. cut, fitted and smoothed off.

The next step was to cut a sheet of paper the exact size of this top, and lay out the various components upon it, until a good arrangement was found. The position of all terminals, holes, etc., was then marked with pencil and transferred to the ebonite, and the necessary holes drilled with an American hand twist drill. The largest hole is ¼ in. in diameter, so large twist drills are not required. For the drilling the ebonite was laid in place on its ledge and the drill rotated until it passed right through into the box. This saved the table and the "mess" was kept within reasonable bounds.

The switches were not mounted in the original way as purchased, but by screws (4 B.A. will do) passed through the ebonite and locked with nuts

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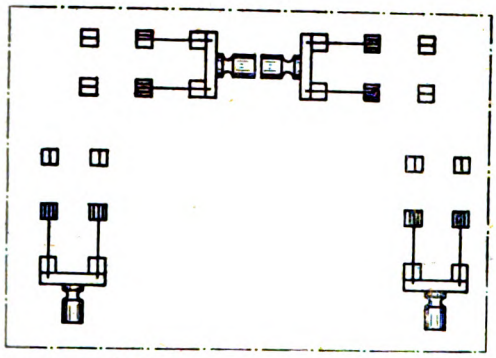

*Fig. 6. Switches set for use of detector valve alone.*

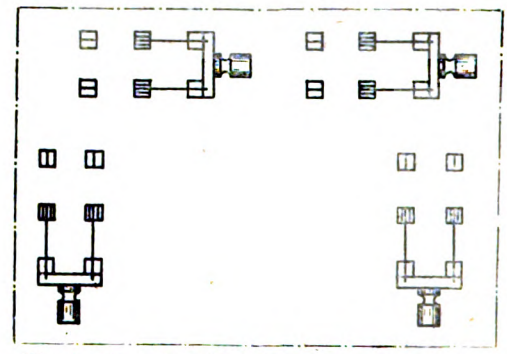

*Fig. 7.—Detector valve and note magnifying valve.*

on top. The connections were then soldered underneath the ebonite to these screws. This makes a neater job than passing the wire through the ebonite and connecting it outside, as with the porcelain arrangement.

The terminals are all standard Mark III terminals, easily obtainable from any dealer for 3d. to 3½d. each. The rotary filament resistances require ¼ inch holes. It will be noticed that separate filament resistances are used for each valve—an arrangement highly recommended if different types of valves are to be tried. It also has the advantage that valves not in use can be switched off. The valve sockets require five holes each—one for each

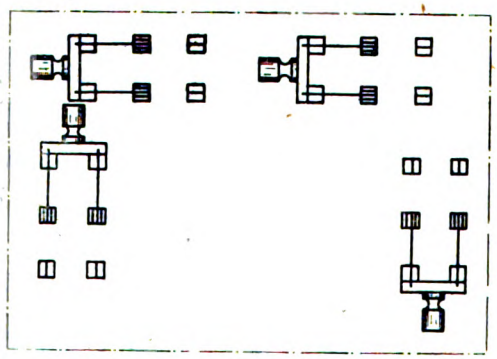

*Fig. 8.—High-frequency amplifier followed by detector.*

pin and one for the central holding screw. The small two-way switch above the centre socket serves to short-circuit the reaction coil. It should be noted that when changing from detector valve alone or with note magnifier to H.F. and detector with or without note magnifier, the connections of the reaction coil must be reversed. A reversing switch would be an improvement here.

When all the holes are drilled (you will be surprised how many there are !) the various components can be screwed into place without difficulty. The most difficult job is the demounting and mounting again of the Sullivan switch for the transformer, as the tiny studs must be carefully set. It would probably be better to buy the transformer without switch and use a larger one than that fitted to the complete transformer. Those who have them could use the separate transformers mounted on valve plugs in this instrument, thus saving expense.

Small mica and copper condensers (·001 microfarad) are shunted across H.T. terminals, telephone transformer primary, and L.F. transformer primary.

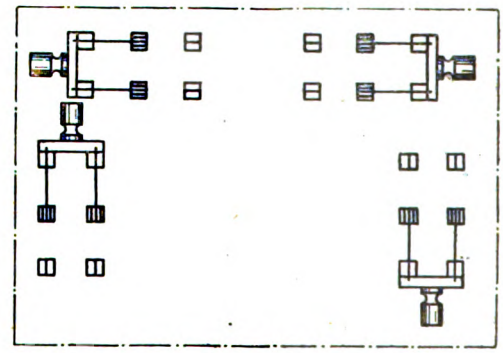

*Fig. 9.—H.F., detector and note magnifier used together. Note: The switch in the right-hand corner connects the final valve either to H.T. telephones (upper position) or transformer and L.T. telephones (lower position, as shown).*

(In a further instalment of this article the wiring will be described and details given of the amplifier panel, together with photographs of the completed station.)

## THE DUTCH CONCERTS.

The following is an extract from a letter received from Mr. H. H. Idzerda, of the Nederlandsche Radio-Industrie, acknowledging the sum subscribed by readers of *The Wireless World* :—

"We have received your letter of February 17th, with enclosed cheque for £62 6s. 6d.

"Whilst we thank you for your remittance, we want especially to express our appreciation to all subscribers and your good selves for the support given and interest shown in our concerts."

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# Experimental Wireless Stations.

## DIRECTORY OF CALLS.

Delete the particulars previously published in *The Wireless World* of the following stations, **2FB, 2KO, 2NR.**

The following additions or corrections should be inserted:—

| Call Letters. | Power in Watts. | Wave-lengths in Metres. | Hours of Working. | System. | Name and Address. |
|---|---|---|---|---|---|
| **2 FB** | 10 | 180<br>1,000 | Various. | Spark, C.W. and Telephony. | W. Ison, 80, Harnham Road, Salisbury. |
| **2 KO** | 10 | 500<br>1,000 | 2000–2200 Weekdays, 1100–1300 Sundays. | C.W. and Telephony. | C. S. Baynton, 48, Russell Road, Moseley, Birmingham. |
| **2 NR** | — | — | 1900–2100 | — | J. Knowles Hassall, Mount Pleasant Works, Wooden Box, near Burton-on-Trent. |
| **2 PA** | — | 180<br>1,000 | 1900–2100 | Spark, C.W. and Telephony | G. Z. Auckland & Son, 395, St. John Street, E.C.1. |
| **2 PX** | 10 | 1,000 | — | C.W. and Telephony. | H. H. Lassman, 4, Avenue Parade, Barking Road, East Ham. |
| **2 QO** | — | — | — | Telephony. | P. Pritchard, Blenheim House, Broad Street, Hereford. |
| **2 RK** | — | 180 | — | Spark. | A. E. Blackall, 7, Maple Road, Surbiton. |
| **2 RB** | 10 | 180<br>1,000 | — | Spark, C.W., and Telephony. | H. B. Grylls, Trenay Fawton, Carew Road, Eastbourne. |
| **2 SD** | — | — | — | — | J. Mayall, Burfield, St. Paul's Rd., Gloucester. Portable Set. |
| **2 SI** | — | Up to 180 & 1,000 | —<br>— | Spark, C.W., T.T., and Telephony. | L. C. Holton, 112, Conway Road, London, N.14. |
| **2 TG** | 10 | 1,000 | — | C.W. and Telephony. | Sheffield University, Dept. of Applied Science, St. George's Square, Sheffield. |
| **2 TH** | 10 | 1,000 | — | C.W. | Sheffield University. Portable Set. |
| **2 TO** | 10 | 180<br>1,000 | 1900–2100 | C.W. and Telephony. | F. Townsend, 46, Grove Lane, Ipswich. |
| **2 UM** | 10 | 180<br>1,000 | 1600–1700<br>1900–2000 | Spark, C.W. and Telephony. | H. Lloyd, 3, Ventnor Place, Sheffield. |
| **1 VP** | — | — | — | — | L. J. Hughes, The Wireless Station, Mombasa, British E. Africa. |

The following French Amateur Stations have now been licensed.

| | | | | | |
|---|---|---|---|---|---|
| **8 AB** | 100<br>200 | 200<br>525<br>1,000 | 2100–2115 and at intervals till 2230. | C.W. | Léon Deloy, Villa des Hautes-Roches, 55, Boulevard Mont-Boron, Nice. |
| **8 AD** | — | About 200 | Sundays 1500–1600 | Spark | J. Roussel, 12, Rue Hoche, Juvisy-sur-Orge, France. |
| **8 AE & TSFM** | — | 200 | — | C.W. | La T.S.F. Moderne, 11, Avenue de Saxe, Paris. |
| **8 AH** | — | 200 | Daily, various | C.W. and Telephony. | Marcel Coze, 7, Rue Lalo, Paris, 16e. |

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# Resistance Capacity Amplification*

BY B. L. STEPHENSON.

THERE are roughly speaking three methods of amplification which can be easily adopted for amateur purposes, these being "Note Magnification," "High Frequency" amplification by means of intervalve transformers, and "H.F." amplification using resistance capacity intervalve couplings.

The first method seems to be the one which has been most generally adopted by amateurs, but as has been frequently explained, it cannot receive stations which would not be, at least, audible using a single valve, under the same working conditions. In other words, as the term "Note Magnification" implies, it merely makes signals which can be received on one valve louder. In addition to this it has the attendant disadvantages of being noisy, owing to the magnetic effects of the iron of the transformers, and costly, for these transformers can hardly be made by the average amateur.

The second method, employing intervalve air-cored transformers, for amplification at radio-frequency (*i.e.*, of the signals before rectification) is undoubtedly the most efficient method of amplification. It amplifies very weak impulses in the aerial-circuit and causes them to become strong enough to operate the rectifying valve, thus causing fluctuations of current through the 'phones. These weak impulses might not be strong enough to cause a single valve to rectify, where no previous amplification was used. This method, however, has a great disadvantage in cost and trouble of operating. The amateur, in most cases, requires an installation which will work with reasonable efficiency on all wavelengths, say, from 400 metres to 20,000 metres. In order to do this he would need about 9 separate intervalve transformers, as well as an extra variable condenser for shunting across their primaries. All this has, I think, been fully gone into, lately, before this Society.

The third method, using intervalve couplings consisting of a high resistance and a capacity is, I think, the simplest of the three, and it has all the advantages of the last two methods, with none of their disadvantages. That is to say, it is both cheap, highly efficient and easy to operate.

First of all we will take a circuit of the usual type, embodying the principles of Resistance-Capacity Amplification.

There are two distinct components of current flowing round the anode circuits. The first is the normal D.C., due to the H.T. battery and limited by the anode resistance, and the resistance of the stream of electrons flowing from the filament to the plate of the valves. This, of course, cannot operate the telephones in any way. The other is the A.C., at radio frequency, which is superimposed on the D.C., when signal oscillations are applied to the grid.

Now it is necessary to maintain the plate of a common "R" type valve at a potential of about 25 volts positive, to ensure efficient working and the normal steady current flowing will be about 0·7 milliamps. From this fact we can easily calculate the necessary H.T. voltage, with any given value of anode resistances. These are given in the following table :—

| *H.T. Volts.* | *Anode Resistance.* | *Amplification.* |
|---|---|---|
| 40 | 20 thousand ohms. | 2 |
| 50 | 38 ,, ,, | 3 |
| 60 | 50 ,, ,, | 4 |
| 70 | 65 ,, ,, | 5 |
| 80 | 80 ,, ,, | 6 |
| 90 | 90 ,, ,, | 7 |
| 100 | 100 ,, ,, | 8 |

If the anode of the first valve is connected direct to the grid of the next valve, this grid will have a potential of about 25 volts positive relative to the filament. This will, of course, render the valve inoperative.

If, however, we put a condenser between these two points we shall effectively stop the D.C., while the high frequency oscillations will be readily able to pass. By this means the proper controlling of the valve is obtained.

These intervalve grid condensers should be made such that they are large enough to pass the H.F. impulses caused by low wavelengths, and their capacity seems generally to be given, in text-books, as between 0·0002 mfd. and 0·0008 mfd. Consequently the value usually given is 0·0005 mfd.

In actual practice, however, very much larger ones seem to work better, particularly between the first two valves. A table can be given as follows :—

Between first 2 valves .. 0·003 mfd.
,, second 2 ,, .. 0·002 mfd.
,, third 2 ,, .. 0·0008 mfd.

and not until the fifth valve do we come down to the 0·0005 mfd. condenser.

Much has been said regarding the loss of efficiency of Resistance-Capacity amplifiers when receiving wavelengths below about 1,000 metres. This may be largely due to the fact that the grid condensers used are too small, and will not pass the H.F. impulses due to short waves. The loss of efficiency is there in any case, but it can usually be made less noticeable by increasing the capacity of the condensers.

The reason for the inefficiency of these amplifiers on short wavelengths is that the valves have an inter-electrode capacity of appreciable value. This has an effect equivalent to shunting the filament anode path with a condenser, which is the same as shunting the anode resistance, and thus providing a path for the H.F. currents. This will lower the resultant impedance of the anode resistance to A.C. and the voltage drop across it will therefore be reduced. This will, of course, lower the amplification factor.

Now the impedance of a condenser to A.C. varies indirectly as the square of the frequency, so that high frequency impulses, caused by low wavelengths will pass the condenser very easily, and thus lower the amplification much more than in the case of longer waves. This will be more readily understood when we study the actual frequencies caused

* A Paper read before the Manchester Wireless Society on December 1st, 1921.

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by certain waves. The frequency of 300 metre waves is 1,000,000, while that of 1,000 metres is 300,000. Now the detrimental effects of the inter electrode capacities vary as the square of these numbers (*i.e.*, as 100 is to 9). So that this effect on a wavelength of 300 metres is roughly 11 times as much as it is on 1,000 metres.

Another centre of discussion seems to be the grid-leaks. If these are of too high a resistance the set seems to "howl" very readily with a low humming sort of note, and C.W. signals are flat. On the other hand, resistances of too low a value certainly stop the "howling," but at a great cost to signal strength, and in some cases the set may stop oscillating, particularly on low wavelengths.

This question of "howling" is extremely vital when using Resistance-Capacity amplifiers, and a great deal of their variableness can, I think, be put down to an unsuitable choice of grid-leaks. Personally I used a standard 3-megohm leak for some time, with a two-valve amplifier, and the set could not be induced to "howl" under any circumstances. Later I took the leak away all together, and the set then "howled" on the least provocation. Signals were stronger than with the 3-megohm leak, but C.W. signals were flat and had a "poppy" sort of note. At present I am using a strip of dry oak 2" long, as a grid-leak, with just a terminal through it at each end for connections. This is very effective and has greatly improved signal strength, at the same time causing continuous wave stations to come in more on their real shrill note. This, of course, enables them to be heard at a greater distance from the telephones. The set "howls" when the reaction coupling is too tight, and best signal strength is found when the set is just off the "howling" point. This is, however, usually the case with any receiver.

(*To be concluded.*

# Notes

### The Telephony Transmissions from Eiffel Tower.

The following notes on the apparatus used in the transmissions of telephony from the Eiffel Tower in the afternoons may be of interest.

The transmissions are made on a wavelength of 2,600 metres, a valve transmitter being employed with four valves in parallel. A plate voltage of 2,300 volts is used to feed the valves and about 800 watts energy is put into the aerial.

A fifth valve of the same type is used to modulate the aerial current, the plate circuit being coupled to the grid circuit of the transmitting valves. The grid of the modulating valve is controlled by a microphone through the medium of an amplifier.

### The Public Subscription for Professor E. Branly.

The public subscription recently opened for Professor Edward Branly has, it is understood, now been closed. The total sum received is 218,253 francs, and though the money is a personal gift to Professor Branly, he intends to devote it to the furtherance of his wireless researches.

### Time Signals from Wellington, New Zealand.

We are advised by the Hector Observatory, Wellington, New Zealand, that in future on Mondays, Wednesdays and Fridays at 10.30 a.m. local time, time signals will be sent out by Wellington Radio. These will be in addition to the programme at present in force for sending out at 8.30 p.m., and the procedure adopted will be exactly the same.

### Magnetic Detectors for Colleges.

We are advised that Messrs. The Wilkinson Motor & Engineering Company, of Lonsdale Road, Kilburn, N.W.6, are prepared to present to any public school having a wireless laboratory or to any wireless society affiliated to the Wireless Society of London, a Marconi magnetic detector in case. A limited number only is available. The only stipulation made is that the instrument remains the property of the school or club in question, and that carriage on the instrument will be paid.

### International Scientific Congress to be held in Belgium.

The Association des Ingénieurs sortis de l'Ecole de Liège are organising an International Scientific Congress to celebrate their 75th anniversary. The congress will be held in Belgium from June 11th to 16th, and an invitation to be present is extended to qualified engineers of Belgium and allied countries. Wireless telegraphy is included under the section devoted to Electricity.

Full particulars are to be obtained on application to Mr. O. Lepersonne, Secrétaire-Général, 16, Quai des Etats-Unis, Liège, Belgium.

### Wireless Navigational Warnings to Airmen.

Information of a specially urgent nature concerning aerial navigation, *e.g.*, warning regarding the discontinuation of navigational aids or obstruction of landing areas at aerodromes, will in future be broadcasted by wireless telegraphy from Air Ministry Wireless Telegraph Station, in addition to being promulgated in the usual manner.

Such notices issued by wireless will be added at the end of the Air Ministry synoptic weather reports transmitted on a wavelength of 1,400 metres C.W. at any of the following times (G.M.T.): 0600, 0800, 1400 and 1900.

### Amateur Wireless Discussed in the House of Commons.

In the House of Commons on March 7th Mr. Hurd (Member for Frome) asked the Postmaster-General if his attention had been called to the development of wireless telegraphy under private enterprise in the United States; whether he was aware that the number of wireless telephone receiving sets had increased in one year from 50,000 to 600,000 and the entire country had been plotted into circuits with a central station so that every rural and urban home might obtain, at a cost below that of an ordinary gramophone, weather forecasts and business information as to prices and market conditions as well as records of sermons, lectures and entertainments; and whether he would endeavour to provide comparable facilities under the Post Office monopoly in this country.

In reply, Mr. Kellaway said: I am aware that there has been a considerable increase in the number of private wireless installations in the United States, but I have no definite information as to the number of such installations, or as regards

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the arrangements for providing the facilities described by the Hon. Member. I understand, however, that in consequence of the danger of interference with Government and commercial communications, the United States Government are considering the restriction of the use of the wireless telephone for other purposes.

Permission to use wireless receiving apparatus for experimental purposes is granted with comparative freedom in this country, the number of installations being at present 7,000. The provision of facilities for broadcasting messages by wireless is under consideration.

Sir Harry Brittain (Member for Acton): How can you interfere with the Government wireless by means of a receiving set?

Mr. Kellaway: I can give one instance which occurred recently in the United States where the Australian and New Zealand Governments both complained that their communications were interfered with by an amateur in California who was trying to wireless a local concert.

Sir Henry Brittain: An amateur receiving station is a different thing.

## The U.R.S.I. Signals.

Amongst the decisions arrived at by the International Conference on Radio Communications held in Paris during June, July and August, 1921, was the necessity for the transmission by a number of transmitting stations, of scientific signals for the purpose of observations relating to the *law of the propagation of energy*.

The *law of the propagation of energy* has not yet been established on a completely and rigorously scientific basis. The study of this question covers the choice of the most convenient analytical formula, the determination of its constants, the examination of the continuous variations that the phenomenon of propagation undergoes and of the causes which produce them, the definition of the methods suitable for the measurement of the very feeble reception currents and of the electromagnetic fields produced, the establishment of the direction along which the propagation of energy takes place, etc. In order to commence the attack upon the problems it has been proposed by the Paris Conference that a certain number of transmitting stations should execute at suitable hours some particular transmissions of which the wavelength (or frequency) and the intensity of the current in the antenna should be accurately measured. A certain number of observers, distributed in the receiving stations of different countries, should record the intensity of these signals, or better, that of the corresponding electromagnetic field and possibly also the direction of propagation.

The signals, to be transmitted under the direction of the Union Radioscientifique Internationale (U.R.S.I.), should last three full minutes; the first minute serving for the regulation of the receiving apparatus and consisting of the repeated emission of a signal composed as follows:—

"URSI of (name of the station)—(wavelength in metres of the emission made the day before)—(intensity of current in amperes during that same emission)" as, for example, "URSI of XY—18,500—230." The succeeding two minutes should be occupied in the emission of a long dash. There should then be sent to the Central Bureau (at Brussels) the schedules of each transmitting station containing the largest possible amount of technical data upon the emissions carried out, on the antenna, on the apparatus, on the meteorological conditions, etc. Analogous data should be despatched also by the stations that send out signals at regular times because they also are able to serve for measurements of intensity of reception. All this data should be rapidly co-ordinated by the central bureau, and should be printed and distributed widely to those interested. Similarly, receiving stations should record all relative data for the purpose of co-ordination of results.

The study of atmospheric disturbances and research in the direction of their elimination is probably one of the most important subjects in connection with wireless telegraphy in the present day.

France has already inaugurated the transmission of U.R.S.I. signals from Eiffel Tower (FL), Nantes (UA) and La Fayette (LY), these having commenced on February 1st.

The transmissions are made daily at the times indicated below:—

### Eiffel Tower (FL).

(Spark Transmission. Wavelength 2,600metres.)

G.M.T.

1035 URSI de FL URSI de FL . . . . . (exact W/L and energy in aerial of the previous day's transmission).

1036 Two minutes dash.

1038 Preparatory signals preceding the ordinary semi-automatic time signals of 1045.

### Nantes (UA).

(Arc Transmission. Wavelength 9,000 metres.)

1415 URSI de UA URSI de UA . . . . . (exact W/L and energy in aerial of the previous day's transmission).

1416 Two minutes dash

### La Fayette (LY).

(Arc Transmission. Wavelength 23,450 metres.)

1955 URSI de LY URSI de LY . . . . . (exact W/L and energy in aerial of the previous day's transmission).

1956 Two minutes dash.

1958 Preparatory signals preceding the scientific time signals of 2000.

*Note.*—In the absence of accurate information as to the exact W/L and energy in aerial of the transmissions of the previous day a series of the letter X will be transmitted in place of these figures.

## A Wireless Reunion Dinner.

A Wireless Reunion, inaugurating what it is hoped will become an annual event, was held at the Trocadero Restaurant on Saturday evening, the 11th instant, when Admiral of the Fleet, Sir Henry Jackson, G.C.B., K.C.V.O., F.R.S., took the chair at a Wireless Dinner. The company, numbering about 150, was composed entirely of those who had served during the great war as wireless officers of one of the fighting services or in an equivalent capacity, and included a large number of senior officers of the Services, the General Post Office, and the leading scientfiic and commercial interests.

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After honouring the toast of the King, the Chairman proposed the health of Senator Marconi in an interesting and reminiscent speech, outlining the growth of the youngest of the practical sciences from its very small beginnings to its establishment as the greatest medium for a system of world communications. He tendered his hearty congratulations to Senator Marconi on his almost unique experience of having seen the results of his genius and application grow to fruition in the course of little over a quarter of a century.

Senator Marconi in reply referred in moving terms to his early association with Admiral of the Fleet Sir Henry Jackson (or Captain Jackson as he then was), who had passed from the role of Inspecting Officer to that of active collaborator, and to whose enthusiastic support the early adoption of wireless by the British Admiralty was largely due. He also paid a glowing tribute, based on personal inspection over various war fronts, to the efficiency of the British Wireless organisation during the great war, and to the skill and devotion displayed both by land and sea.

The Chairman in complimenting the Organising Committee responsible for the arrangements proposed the health of its Chairman, Colonel L. F. Blandy, D.S.O., R.E.

Colonel Blandy in reply explained the origin of the idea of holding a Reunion and proposed that a Wireless Dinner Club should be formed, and an Annual Dinner arranged on the lines of the present dinner. He proposed, that in the first instance, qualification for membership should be the same as that which guided the Committee in arranging the dinner this year, *i.e.*, that membership of the Club should be confined to those who had done wireless work during the great war as officers or in an equivalent capacity.

The proposal was welcomed and everyone present at the Dinner joined the newly inaugurated Wireless Dinner Club, Admiral of the Fleet Sir Henry Jackson kindly consenting to be the first President.

# Calendar of Current Events

April 5th.—Cambridge and District Radio Society.

April 5th.—Cowes and District Radio Society. Open Night.

April 6th.—Luton Wireless Society. "Resistance Amplifiers," by Mr. F. Halstead, 8 p.m.

April 7th.—Wireless Society of Highgate. "Valve Characteristics and Practical Measurements of Valve Constants," by Mr. L. Grinstead.

April 7th.—Sheffield and District Wireless Society. "Syntony and Resonance," by Mr. F. G. Gilberthorpe. 7.30 p.m.

April 12th.—Cowes and District Radio Society. "Semi-Aperiodic Amplifiers and the Reaction Principle."

April 12th.—Radio Scientific Society, Manchester, 61, High Street, Manchester. Open evening.

April 13th.—Liverpool Amateur Wireless Society, Colquitt Street, Liverpool. "Accumulators: How Made, Used and Abused," by Mr. S. K. Wilkie.

April 13th.—Ilford and District Radio Society. Social Evening.

April 14th.—Leeds and District Amateur Wireless Society, University of Leeds, College Road, Leeds. "Samuel Morse," by Mr. W. R. Plowers. "High Frequency Intervalve Transformers," by Mr. G. F. Kendall, B.Sc. 8 p.m.

## SHARE MARKET REPORT.

Prices as we go to press, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary . .. | £2 | 0 | 6 |
| „ Preference .. .. | 2 | 0 | 0 |
| „ Inter. Marine .. .. | 1 | 6 | 7½ |
| „ Canadian .. .. | | 6 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | | 14 | 9 |
| Preference .. .. .. .. | | 14 | 0 |

# Correspondence

*To the Editor of* THE WIRELESS WORLD.

SIR,—We take the liberty to inform you that a wireless society, the "Norsk Radio-Amateurklub," has recently been formed in Norway and has already acquired many members. We see from various letters from you to Mr. K. E. Weedon, Kristiania, who is one of our members, that you will kindly publish reports from our Society occasionally, and therefore enclose a short paragraph, which we should like to see published in your paper, which, by the way, is very much appreciated by our members as a most valuable and interesting source of both information and entertainment for the "Wireless" man.

From the enclosed notice you will realise that we shall have to meet with many difficulties in our work to liberate the amateurs in this country. However, we have decided upon a method of progress which will certainly lead to a result, whichever this may be, and we hope that our Government will understand, that the absolute prohibition of wireless work is, in the long run, an impossibility, and that the Government had better grant some freedom voluntarily.

Thus we hope within a not too long time to have reached a position approaching that of the English amateur.

Taking into consideration your kind interest in our position formerly, we trust that you will find this information of interest.

G. H. PETERSEN,
*Hon. Secretary.*
*Norsk Radio Amateur Club.*

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*To the Editor of* The Wireless World.

Sir,—On the 2nd March, from 1800 to 1830, I heard 2LQ transmitting music, and afterwards speaking, to 2LM and 2CW on just over 1,000 metres.

As none of these call letters appear in your lists I should be obliged if you can advise me who 2LQ is, or, failing this, if you would be good enough to publish my letter in order that I may get into touch with him.

He may be interested to hear how I received him.

W. Harwood Moon,
*Captain.*

*To the Editor of* The Wireless World.

Sir,—I notice among the correspondence in *The Wireless World* for February 18th a letter on "freak" aerials, from Mr. Williams, in which he asks if any other amateurs have done anything in this line.

I have made several experiments with different "aerials," and have also noticed that static is greatly reduced with certain types.

One thing I tried was using the earth only, but connecting it to the aerial terminal of the receiver, all the European high-powered stations come in readably and NSS, WII, etc., can just be heard, using one rectifying and one note magnifying valve; by adding another stage of note magnification, the American stations are quite readable.

Has Mr. Williams tried disconnecting aerial and earth, but leaving a tuning circuit across A and E? (I used a 0·001 condenser in parallel with a honeycomb coil 4 inches outside diameter). Then, by standing the coil upright on its edge, directional reception is possible; but, of course, greater amplification is necessary in this case. I found that with the above, and using two H.F. valves, one rectifying and one note magnifying, IDO, POZ, Stavanger, etc., are quite easily read.

Referring to the end of Mr. William's letter, some time ago, while receiving NSS on one valve, I removed the grid leak and substituted my fingers without any change in strength of signals.

Hoping to hear of more "stunts,"
S.E. 25. C. H. P. Nutter.

*February 16th*, 1922.

*To the Editor of* The Wireless World.

Sir,—The explanation given by Mr. Clinker to "Experimenter" on page 610 of your issue for December 24th, appears undoubtedly to be the correct one. It does not seem possible to me to obtain a "Lower Harmonic," *i.e.*, one having a longer wavelength than the fundamental for the following reason.

Given a wire stretched at a constant tension between two fixed points, the wire, if struck, will vibrate at a certain frequency $N$ having a wavelength $L$. This will be the natural or Fundamental $N$ and $L$ of the wire. By touching it lightly half-way up and striking it the frequency alters to double the Fundamental, *i.e.*, to $2N$ and the wavelength correspondingly decreases to $\frac{L}{2}$ This is known as the first harmonic in music, but apparently as the second harmonic in wireless. I use the latter nomenclature. By touching the wire $\frac{1}{3}$rd or $\frac{1}{4}$th of the way up, the 3rd and 4th harmonics can be produced, having rising frequencies of $3N$ and $4N$, and shorter wavelengths of $\frac{L}{3}$ and $\frac{L}{4}$ and so on.

Now for a "Lower Harmonic" one must somehow obtain a frequency of $\frac{N}{2}$ with a wavelength of $2L$. I cannot conceive how this can be done without altering the given conditions.

In experimenting with a banjo it was found when the top D was struck the lower D also vibrated. This would appear contradictory to what has just been written. The explanation is I think the bottom D vibrates not because the top D radiates a lower harmonic but by virtue of the bottom D being inherently able to respond through a higher harmonic and so resonate with the higher frequency of the top D.

These harmonics are a nuisance generally, but are sometimes very useful. With a heterodyne wavemeter, range 1,000-2,500 metres, by means of harmonics, I am able to measure all wavelengths between 300 and 25,000 metres with a very fair degree of accuracy. The wavemeter harmonics are utilised for wavelengths below 1,000 and the Receiver Harmonics for those above 2,500 metres.

Regarding "Experimenter's" letter. If **GSW's** transmitting fundamental wavelength be taken as 5,000 metres, then to get what he calls a "Lower Harmonic" his receiving set must have been tuned to something in the vicinity of 10,000 metres, the second harmonic from it would then beat with **GSW.** The same thing would happen if his receiver were tuned to 15,000, 20,000, 25,000 or 30,000 metres provided the harmonics given out by his receiver were powerful enough. These harmonic effects would be due entirely to his receiver and not to **GSW.** As the Inductance has been increased, naturally it is necessary to increase the Reactance to get an optimum value and signals would therefore gain in strength as the coupling is made closer.

On the other hand; with what he calls the higher harmonics, this effect is due entirely to **GSW,** and I take it "Experimenter" is fairly close to this station. With **GSW** transmitting on 5,000 metres he will be radiating harmonics with wavelengths of 2,500, 1,666, 1,250, 1,000 and so on, and "Experimenter's" set if tuned to near these wavelengths would pick them up. Naturally again a weaker coupling giving less reactance will be necessary with the smaller value of Inductance.

It may interest D.H. (Sutton) and Ohm Sweet Ohm (Hampstead), who ask questions on the subject, to know that **BYC** is easily read at Bushire on one valve and Annapolis fairly well on two valves. With three valves **POZ, IDO, YN** and **OUI** come in fairly loud on a plain "Burndept" type of coil without any aerial or earth. The ordinary resistance capacity coupling set is used. Distances are roughly 3,000 and 9,000 miles to **BYC** and **NSS.**

Gordon Barnes.

Bushire W.O.,
Persian Gulf.
*February 1st*, 1922.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## The Wireless Society of London.

The forty-fifth Ordinary General Meeting was held on Tuesday, February 28th, at the Institution of Electrical Engineers at 6 p.m.

The **President**, opening the meeting, said:

Ballot papers have been circulated and will be collected at the end of the meeting for the election of new members to the Society.

The following Societies have been affiliated:—The Radio Society of South Africa, Kensington Wireless Society and the Highgate Wireless Society.

Mr. Henry Mitchell has been made a full Member—formerly he was an Associate Member.

*A Presentation of Prizes gained in the Transatlantic Tests was then made to the first prize winner, Mr. W. R. Burne, who also acted as the representative of other prize winners not present.* (*See page* 10 *of this issue.*)

After the presentation the **President** said:—

I will now call upon Mr. Phillips to open the Discussion on High Frequency Application.

At the conclusion of the Discussion (for which see next issue) the President announced the election of the following to be Members of the Society: Rev. C. H. Townson, G. A. Exeter, H. J. Talbot, J. Gillett, R. A. Palmer, W. H. Lloyd, A. W. Fithian, H. G. Treadwell, H. Taylor, O. J. Carpenter; and Associate Members, M. Burchill, Felix M. Loufté, K. P. Strohmenger.

The meeting adjourned at 8 p.m.

## Liverpool Wireless Association.*

The Fourth Meeting of the Liverpool Amateur Wireless Society was held at the Royal Institution, Colquitt Street, Liverpool, on February 23rd last. Dr. Marchant, who was in the chair, in introducing Mr. W. R. Burne (Transatlantic Test winner), said that they were indeed very fortunate to have Mr. Burne to lecture to them. It was a noteworthy achievement that an amateur had bridged the Atlantic with only one kilowatt. Marconi, in his experiments, when only coherers were available for receiving, used about 10 kilowatts. Knowing what we do now about Transatlantic transmission, it seems likely that Marconi made his first tests on a very favourable night.

Mr. Burne, at the outset of his address, congratulated Mr. Forshaw, of Liverpool, on his success. Mr. Burne then went on to say that he had heard one station over 3,700 miles away sending with a power of 1 kilowatt, and that it spoke very well for the American amateur stations. In the case of these big commercial stations Mr. Burne said the tendency was to turn loose a large power rather than to have efficiency at the receiving end. He went on to say that he believed that with a good receiving set it was, in his opinion, not unlikely that the amateurs would succeed in getting messages across the Atlantic with 100 watts; he was himself contemplating a set of this power with a view to doing this, and pointed out that he had succeeded in working regularly with an amateur in Surrey with an input of less than 1 watt. He said, in conclusion, that he hoped the British Post Office authorities would let all amateurs work on any wavelength under 250 and do away with the longer wave, adding that in his opinion the day would come when amateurs would be compelled to work on long waves, while the commercial stations would use the shorter waves, as these were far better for long-distance work.

Professor Marchant, in proposing a vote of thanks, pointed out that in the early days of wireless, short wavelengths were preferred. Hertz, in his original papers, showed that the rate of radiation of energy was inversely proportional to the square of the wavelength. It was only when very long distances had to be covered that longer wavelengths were used, because it was found that the absorption of the longer waves was less than with the shorter waves. There is, in fact, a best wavelength for any particular distance of transmission, and that for the Atlantic is in the neighbourhood of 7,000 or 8,000 metres. The transmission of Transatlantic signals, therefore, with a wavelength of only 200 metres, is a most interesting and important achievement.

Mr. Forshaw seconded the vote of thanks, which was carried with prolonged applause. About sixty members attended.

The Fifth Meeting of the Liverpool Wireless Society was held on March 9th last, when Mr. H. Clarke, of Liverpool University, delivered a paper on the Thermionic Valve.

Hon. Secretary, Mr. James K. Wilkie, "Avondale," Knowsley Road, Cressington Park, Liverpool.

## Kensington Wireless Society.*

A Meeting was held at 2, Penywern Road, Earl's Court, on Thursday, March 2nd, at 8.30 p.m. After the business of the evening had been transacted the President called upon Mr. Maurice Child to give his lecture on "Transmitters," with "Demonstrations of Adjustments to Transmitting Gear."

Mr. Child commenced by dealing with the early Hertz, Lodge and Marconi oscillators, and demonstrated by means of a large quantity of apparatus, the defects and advantages of condensers, rotary and fixed gaps, tight and loose coupling, etc., in spark transmitting circuits.

A very hearty vote of thanks was tendered to Mr. Child and, after some discussion, the meeting was adjourned.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, S.W.10.

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### The Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13A, Sedgemere Avenue, East Finchley, N.2.

The membership of this Society is still increasing, and we have now nearly thirty members on the books. The Society has now been able to arrange to hold its meetings regularly at the Highgate Literary and Scientific Institution, South Grove, Highgate, N., and an aerial has been erected on the roof of that building. A G.P.O. licence, both for receiving and for transmission (artificial aerial only) has been obtained, and a sub-committee has been appointed to deal with the installation of the Society's receiving set. The Society's call letters are 2US.

The following lectures have been given since the last report: February 3rd, Mr. L. Grinstead, "Amplifiers"; February 17th, Mr. D. H. Eade, "The Electron Theory"; March 3rd, Captain W. R. H. Tingey, "Wireless Reception."

The lecture kindly given by Captain Tingey proved most interesting. Much interesting apparatus had been brought by the lecturer, and he illustrated his remarks throughout by experiments. Exceptionally loud signals were obtained, including some music from Captain Tingey's works at Hammersmith, the latter being reproduced on the loud speaker with remarkably little distortion.

The Hon. Secretary would welcome enquiries from anyone interested in wireless who is desirous of applying for membership of the Society.

### Cambridge and District Wireless Society.*

Hon. Secretary, Mr. J. J. Butterfield, 107, King Street, Cambridge.

A very successful meeting was held in the club-room, Ram Yard, on Wednesday evening, March 8th, when Mr. Farren was in the chair and Mr. Barron, of the Cambridge and Paul Scientific Instrument Company, lectured on "Ray Track Working." Mr. Barron showed a series of lantern slides illustrating the tracks of alpha, beta and X-rays. These were actual photographs and were obtained by photographing the rays at the moment they were shot off from a particle of radium enclosed in a glass chamber containing air saturated with water vapour, and, on the air being suddenly expanded, the rays left a track of vapour behind them. The Ray Track apparatus for showing these tracks was then demonstrated, and thanks are due to the Cambridge and Paul Scientific Instrument Company for the loan of the apparatus. Mr. Barron's kindness for bringing along so much interesting apparatus was thoroughly appreciated.

### Cowes and District Radio Society.*

Hon. Secretary, Mr. A. Ball, "Pretoria," Castle Street, East Cowes, I.W.

The above Society is now in a very favourable position, and upwards of thirty members have now been enrolled. Thanks to our President (S. E. Saunders, Esq., O.B.E.), we have got headquarters, and some very interesting work is being done. Meetings are held every Wednesday evening at 7 p.m., and anyone interested will be cordially welcomed. The annual fee for membership is 7s. 6d.

### Stoke-on-Trent Wireless and Experimental Society.*

To close a very successful year we are holding an Exhibition of Wireless Apparatus in the Town Hall, Burslem, on March 30th, 31st and April 1st. By doing this we hope to encourage amateur wireless in our district. Demonstrations will be given during the time the exhibition is open with various methods of reception of telegraphy and telephony.

Soon we hope to be in possession of a transmitting licence, which will be much appreciated in our town, because at present there is no local transmission of telephony or telegraphy.

Any person interested should apply to the Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

### North Middlesex Wireless Club.*

The 86th meeting of the Club was held on the 8th March and was very well attended. The occasion was an Auction Sale and Exhibition of Instruments. There were some excellent instruments on show, but the majority of those brought to the hall were for sale. The autioneers were Messrs. Dixon and Evans, and those who expected the proceedings to be lively were certainly not disappointed.

The President thanked the two gentlemen who had acted as auctioneers, and had materially contributed to the success of the evening.

Particulars of the Club may be had from the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Bradford.

A meeting was held in the clubroom at 7.45 p.m. on March 10th, with Mr. W. C. Ramshaw, in the chair. After the business of the meeting the Chairman called upon Mr. J. Bever to continue his lecture on the "Principles of Wireless Reception." At the conclusion of the paper a hearty vote of thanks was accorded. The attendance was very good.

### Sheffield and District Wireless Society.*

Hon. Secretary, Mr. L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

On the 24th February, at the Department of Applied Science, George Square, Mr. A. F. Carter exhibited a 7-valve receiving set fitted into a writing cabinet, and gave a practical demonstration. He pointed out the various difficulties which had to be overcome, also the best arrangement to get the maximum results. A critical and informative discussion followed.

On the 10th March Mr. A. Horton read a paper on "Mark III Conversion."

Several converted Mark III sets were exhibited and their advantages and disadvantages pointed out.

### Cardiff and South Wales Wireless Society.*

A general meeting was held at headquarters on Thursday, February 9th, Mr. N. M. Drysdale presiding.

Mr. H. C. Linck delivered a lecture on "Telephone Relays." Mr. Linck is to be congratulated upon the masterly way with which he treated this subject, and a hearty vote of thanks was tendered to him for his interesting lecture.

On Thursday, February 23rd, 1922, Mr. A. H. G. Field gave a lecture on the "Basic Principles of

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X-rays." The lecturer dealt with the theory of light and sound, proving that both are produced by vibrations, and it was clear that we were able to get inaudible sound as well as invisible light.

A very hearty vote of thanks was accorded to Mr. Field.

Hon. Secretary, Mr. P. O'Sullivan, 16, Adamsdown Square, Cardiff.

### Burton-on-Trent Wireless Club.*

At a meeting of the Club, held on Friday, February 24th, Mr. A. J. Selby gave an interesting lecture on "Ether Waves and Ideas Obtained from the Spectrum." There was a large attendance, including several visitors. Mr. Selby explained the various groups of ether waves, the nature of light, the origin of colours, and electro-magneto waves. A spectroscope was exhibited and explained. A very interesting discussion followed, and a vote of thanks was accorded to Messrs Selby and Parkin, who kindly lent and demonstrated the spectroscope.

Hon. Secretary, Mr. A. J. Selby, 66, Edward Street, Burton-on-Trent.

### The Lowestoft and District Wireless Society.

Hon. Secretary, L. W. Burcham, "Gouzeacourt," Chestnut Avenue, Oulton Broad.

The First General Annual Meeting was held on March 7th at the new Headquarters at St. Margaret's Institute, Lowestoft. The President (Mr. C. Chipperfield), in his opening address, reviewed the progress of wireless telegraphy, the useful work done by the society and its members in the past year since the society's inauguration. The number of stations operating in March, 1921, were 5 crystal, 1 valve reception and 1 spark transmitter; to-day there are 10 multi-valve, 3 single-valve, 3 crystal reception and 2 spark and 2 valve and telephony transmitter stations in operation.

The balance sheet presented by the Treasurer showed a modest balance in hand of 11s. 2d. on the year's financial transactions. There being no discussion, the balance sheet was adopted.

Ballot papers were then distributed for the election of officers, etc. In the Chairman's report on the work for the forthcoming year, details were given of the proposed exhibition, to be held in Lowestoft on the 3rd and 4th August of this year, also various schemes for field days and outdoor work. The Secretary's report on fees, etc., is as follows: Members' fees, 7s. 6d. per annum and 5s. after September 1st; Associates, 3s. per annum and 2s. after September 1st; also a levy of 6d. per month to be made to cover cost of clubroom.

The result of the election being to hand, the Chairman announced that the Officers and Committee had all been unanimously re-elected. The Committee is preparing new fees for provincial members. Will all those interested in the Society please communicate with the Secretary.

### The Leeds and District Amateur Wireless Society.*

A General Meeting was held at the Leeds University on February 24th. At 8 p.m. Mr. G. P. Kendall, B.Sc. (Vice-President), took the Chair and called upon Mr. C. P. Hall to deliver a paper on "The Theory of the Valve." This lecture had been specially arranged for the junior members, who turned up in large numbers and benefited greatly as a result of the lecturer's remarks. Apparatus, kindly loaned by our President (Professor R. Whiddington, M.A., D.Sc.), was exhibited by Mr. Hall, who at the close of his paper and discussion demonstrated the method of plotting valve curves. A hearty vote of thanks was accorded to Mr. Hall.

Mr. Kendall then vacated the Chair, Mr. A. M. Bage presiding. The Chairman called upon Mr. Kendall to deliver his paper on "High Frequency Intervalve Transformers." The lecturer briefly outlined the essential differences between H.F. and L.F. intervalve transformers, both from the electrical and mechanical points of view. At the close of the discussion a vote of thanks was proposed and carried amid loud applause.

Mr. A. M. Bage exhibited a "Bage" loud-speaking telephone at the meeting, the instrument having been constructed at home.

On Friday, March 10th, at the Leeds University the Morse class was under the direction of Mr. P. Cockroft. At 8 p.m. Mr. A. M. Bage (Vice-President) took the Chair.

Mr. R. E. Timms delivered his lecture on "High Speed Line Telegraphy." Amongst the very numerous apparatus on view were a Creed perforator, a Wheatstone transmitter and a printing receiver, all of which were described in some detail. A discussion followed, after which the apparatus was closely examined by a very enthusiastic audience. A hearty vote of thanks was accorded to Mr. Timms and delivered after the usual manner.

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

### Wireless and Experimental Association.*

At a meeting at the Central Hall, Peckham, on March 2nd, members turned their attention to the previous night's reception of the Princess Mary wedding music. All members agreed that the modulation was as nearly perfect as possible and the Secretary was instructed to write to the Marconi Scientific Instrument Company to express their thanks.

At the Central Hall, Peckham, on Wednesday, March 8th, the Committee considered the proposals of the London Wireless Society with regard to representations to the Postmaster-General for revising the regulations applying to wireless amateurs. After a prolonged discussion it was unanimously agreed that the London Wireless Society had handled the matter in a splendid manner, and pledged the Wireless and Experimental Association to support unreservedly the steps that had been and were being taken.

Hon. Secretary, Mr. Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

### Plymouth Wireless and Scientific Society.*

On Wednesday, February 8th, the members of the Society attended a lecture of the Junior Institution of Engineers, on the subject "Alternating Current Motors."

On February 15th the ordinary weekly meeting was held, at which a lecture on Radium and Radio-Activity was given by Mr. C. E. Harris. Dealing with the subject historically at first, the lecturer mentioned the work of Becquerel, the Curies, and Rutherford.



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On Wednesday, February 22nd, an exhibition of apparatus was held at Plymouth Technical College. Several complete sets were on view and at work. Some very fine signals were obtained on a 5-valve set, with separate heterodyne. A show of various wireless components of Messrs. Auckland proved a centre of attraction.

On Wednesday, March 1st, a lecture was given by Mr. P. Arberry on "Heterodyne and Autodyne." The lecturer himself is an enthusiastic believer in separate heterodyne, but succeeded in giving us a perfectly unbiased account of the two methods.

There is still plenty of room in the Society for new members, and the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport, would be glad to hear from prospective members.

**The Wireless Society of Hull and District.***

At a recent meeting, Mr. J. Nicholson, A.M.I.M.E., gave some very useful advice on the upkeep and care of accumulators, which are so essential to all wireless experimenters in these days of valve reception. Mr. W. J. Featherstone occupied the chair, and at the close of the meeting moved a vote of thanks to the lecturer.

On Monday, February 27th, a meeting of the committee was held under the chairmanship of Mr. Henry Strong (Vice-President), when a number of matters were dealt with. The Hon. Secretary reported that the membership had now reached 34, and that the funds in hand amounted to £10 15s. 8d., which was considered very satisfactory.

Mr. G. H. Strong (President) occupied the chair at the ordinary meeting of members which followed, when there was a good attendance to hear a paper read by our Vice-President, Mr. Henry Strong. The lecturer treated those present to a clear explanation of elementary electricity and magnetism which led up to present day wireless.

Mr. Henry Strong was accorded a hearty vote of thanks on the proposition of Mr. J. Nicholson.

The fortnightly meeting of the Society was held on Monday, March 6th. Mr. G. H. Strong (President) presided over a good attendance of members.

After some routine business was dealt with, Mr. Henry Strong, A.M.I.N.A., M.I.Mech.E., gave a very comprehensive and instructive paper on "Valves." At the conclusion the lecturer was heartily thanked on the proposition of Mr. Jephcott, which was seconded by Mr. Snowdon.

Further intending members will be welcomed, and should apply for particulars to the Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull.

**Southport Wireless Society.***

Hon. Secretary, Mr. W. E. Otter, 5, Tower Buildings, Leicester Street, Southport.

The usual weekly meeting was held in the Queen's Hotel, Promenade, Southport.

It was announced that the late Secretary, Mr. Eustace Field, had been re-elected Associate I.R.E.

Will all interested in wireless in Southport or Birkdale district, please communicate with the Hon. Secretary.

Since the purchase of a four-valve German low-frequency amplifier, signals are not so elusive, and the Club-room is to be repaired during the next few days, thanks to our Chairman and a few members.

**The Thanet Radio and Experimental Society.**

All communications to be sent to the Hon. Organising Secretary as below.

The above Club had a very successful show and demonstration of wireless apparatus at the Art and Industries Exhibition, held at the Margate Pavilion and Winter Gardens, January 25th to February 4th. (A description will be published later)

As members are coming in from the surrounding towns it has been decided to alter the name of the Club to The Thanet Radio and Experimental Society, and a long and useful life of this Society is confidently anticipated.

Hon. Secretary, J. H. Byes, 33, Richmond Avenue, Margate.

Hon. Organising Secretary, Mr. H. M. Wainman, 10, Norfolk Road, Margate.

**Edinburgh and District Radio Society.***

A General Meeting was held on March 1st. Business being concluded, the chairman expressed his appreciation in welcoming Mr. Forbes Boyd, of the Sheffield Society, who had so kindly come forward to give a paper on "Direction Finding."

Mr. Forbes Boyd dealt with his subject as very few others could have done, explaining where improvements were required and how, in spite of innumerable difficulties, they had been achieved.

After the usual discussion the meeting expressed their gratitude to Mr. Boyd, in passing a very hearty vote of thanks.

Hon. Secretary and Treasurer, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

**The City and Guilds Wireless Society.***

The above Society held a General Meeting on Wednesday, February 8th, with Mr. H. J. B. Chapple, B.Sc., in the chair. Business being concluded, the President (Professor E. Mallett, M.Sc.) delivered an address entitled "Wired Wireless."† The address was devoted to an outline of the subject upon which Professor Mallett has done much research work, and was presented to a good audience in a most interesting form. The subject is one which is still in its infancy, and not well understood, though its possibilities in long-distance telephony are very great.

At the close of the meeting a very hearty vote of thanks was accorded the President.

**Preston Scientific Society.***

A General Meeting was held in the Society's rooms, 119a, Fishergate, on December 19th, 1921, when the following Officers and Committee were co-opted to carry on until the Annual General Meeting to be held on Monday, March 27th, 1922. Chairman, Mr. W. J. Rolfe, A.M.I.E.E.; Vice-Chairman, Mr. W. Paddock; Hon. Secretary, Mr. A. Pickering; Committee, Messrs. J. H. Morris, J. N. C. Bradshaw, W. J. Bryce, W. Beattie, A.M.I.E.E., C. C. Breakall, T. Melling and W. Danson.

On January 18th a lecture on "Wireless Telegraphy and Telephony" was given by Mr. W. Paddock, before an audience numbering 80.

A lecture on "High Frequency Amplifying" was given on February 6th by Mr. J. N. C. Bradshaw.

Will members please note that meetings will be held every Monday evening until further notice. Any particulars of membership will be supplied on application to the Hon. Secretary, A. Pickering, 16, Bispham Street, Preston.

† This paper will be published in a subsequent issue

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### Brighouse and District Wireless and Experimental Society.

The first meeting of the above Society was held in the lecture room at the Liberal Club on Monday, February 13th.

It is proposed to hold instructional and buzzer practice classes one night each week.

In the winter session a series of lectures will be held.

Mr. R. A. Blakeborough, Toothill Hall, Rastrick, was elected President.

Although new, the society has now about 26 members. Will anyone interested in the society please communicate with the Secretary, at Oak View, Rayner Road, Brighouse. The headquarters of the Society will be notified later.

### Redhill and District Y.M.C.A. Wireless Society.

On February 8th an exhibition of members' apparatus was held. A coil winding machine by Mr. J. S. B. Clarke, was one of the attractions.

On February 15th, Mr. R. L. Dawson gave a very interesting lecture on inductance, giving the various formulae used in its calculation, and explaining their derivation. He was accorded a hearty vote of thanks for his efforts, his lecture being greatly appreciated by those present.

An interesting demonstration of a two-valve receiver was given by Mr. J. S. B. Clarke on March 1st. He showed the connecting up, and members had an opportunity of trying the set for themselves, from which much amusement was derived.

The Society's licence having been obtained it was decided to erect the aerial as soon as possible.

### Dundee and District Amateur Wireless Association.

At a meeting of the above Association held at the Club Rooms, Morgan Academy, Dundee, on Tuesday, February 17th, Mr. R. L. D. Kennedy lectured on Set Construction.

As the Club valve set is built on the same lines as Mr. Kennedy's own set, members obtained the additional advantage of listening to a most interesting lecture, in which the Club set was included.

Hon. Secretary, Mr. R. H. B. Candow, 33, Cowgate, Dundee.

### Bolton Wireless Society.

Hon. Secretary, H. Chadwick, 9, Raimond Street, Bolton.

On Tuesday, February 14th, in the new headquarters, Bradford Buildings, Mawdsley Street, the Society had the pleasure of making the acquaintance of Mr. J. McKernan of the Manchester Wireless Society, and spent a very absorbing evening on the wonders of "High Frequency Currents."

The lecture was ably given by Mr. McKernan, and was repeatedly illustrated with practical experiments, the instruments forming a very imposing show when arranged on the table. Mr. McKernan was warmly thanked and applauded for his efforts.

A sale of members' spare gear was held in the headquarters on February 21st, and continued on the 24th. The Society benefited by a prearranged percentage on all sales.

On Tuesday, March 7th, we were honoured by a visit from Mr. W. R. Burne, who is now so well known as to need no introduction.

Mr. Parkinson, in the chair, called upon Mr. Burne to give a few words of advice regarding wireless telegraphy working.

Mr. Burne responded with a description of various types of high frequency amplifiers, about which most of us know so little. He described the resistance, reaction and transformer coupled circuits, the last named being dealt with in detail, as it is in this type that most of us are interested, Mr. Burne having used them in the Tests.

At the conclusion of the lecture Mr. Burne was kept busy answering questions, and some very knotty points on high frequency work were straightened out, after which Mr. Parkinson moved a vote of thanks; this was heartily accorded by all present.

Hon. Secretary, Mr. H. Chadwick, 9, Raimond Street, Hallwell, Bolton.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. Cutler, 24, Floating Bridge Road, Southampton.

A very successful meeting of the newly formed Society was held in the Kingsland Assembly Rooms, Southampton, on Wednesday, March 8th. Arrangements were made for the buzzer practice, etc. The Club aerial will be erected in the course of a week. Application is being made for the use of receiving and C.W. transmitting gear, and it is hoped that concerts will be given weekly. Mr. Freeman was elected Chairman. The aims and objects were discussed and rules drawn up and confirmed.

New members will be welcomed, and enquiries from anyone in Southampton and district interested will be gladly answered by the Secretary.

### Hounslow and District Wireless Society.

The above Society have secured permanent headquarters at the Council House, Hounslow, where they hope to settle down to serious work. The Society is still handicapped for apparatus, but hope to get this as they go along. A junior section has now been formed, and in time should be a great success. Application has been made for affiliation to the London Wireless Society.

On February 16th a demonstration and lecture was given by Captain Tingey. The lecturer first dealt with the aerial earthing arrangements. He next proceeded to demonstrate his apparatus, showing both low frequency and high frequency amplification.

Mr. A. R. Pike thanked the lecturer and proposed a vote of thanks which was heartily carried.

Meetings are held at the Council House, Hounslow, each Thursday at 8 p.m.

Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow.

### Ilford and District Radio Society.

This Society has been fortunate in securing more central headquarters at St. Mary's Church School, Ilford.

A most enthusiastic gathering listened to a lecture given by Captain Tingey on January 18th, the subject being "Faults," which were dealt with in a very practical manner. The lecture was much appreciated by all present.

On February 8th, Mr. Rope, one of the Society's members, gave an instructive address on Accumulators, and many of us learned to appreciate more the value of this important piece of apparatus

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and will certainly give it more care and thought in the future.

On March 2nd, Mr. Welsh, the Senior Vice-President of the Society gave his long-promised lecture on "Alternating Currents." The lecturer at the close was asked many knotty questions which he ably answered.

Hon. Secretary, Mr. Lionel Vizard, 12, Seymour Gardens, The Drive, Ilford.

### The East London Radio Society.

Hon. Secretary, Mr. L. E. Lubbock, Hay Currie School, Poplar, E.14.

The above Society has been very fortunate in having two rooms put at their disposal. One in the Lecture Hall, Woodstock Road, and the other in King George's Hall. Though recently formed, we are pleased to report that substantial progress has been made, and the membership now totals fifty. Meetings are held on Tuesday evenings at 7.30 when practical work and experiments are carried out, and on Saturday afternoons from 3 p.m. to 5 p.m. for lectures.

On February 11th a demonstration in Wireless Telegraphy and Telephony was given by Mr. F. O. Read, on apparatus kindly lent by Messrs. Burnham of Deptford. The meeting was well attended, and we are greatly indebted to Mr. Read for a very instructive and enjoyable evening.

A series of lectures has been given by Mr. Haines and Mr. Keens; the former on the construction and working of one and two-valve sets, and the latter on High Frequency Currents, and the Action of the Telephone.

Arrangements are being made for affiliation with The Wireless Society of London.

### Wolverhampton and District Wireless Society.

At an informal meeting held at 26, King Street, Wolverhampton, on March 1st, it was decided to form a Wireless Society for Wolverhampton and District. Twenty-four prospective members attended and were enrolled, and as many others who were unable to be at the meeting have expressed their desire to join, there is every prospect of a strong membership. The following officers were elected:—

Chairman, Mr. H. H. Speke; Hon. Secretary (*pro tem.*), Mr. G. W. Jones; Hon. Treasurer, Mr. F. G. Redhead; Committee, Messrs. H. Stevens, H. Taylor, H. L. Freakley, J. H. Devey, T. W. Higgs, Geo. W. Fairall.

The second General Meeting was held on Wednesday, March 15th, Mr. H. H. Speke in the chair. There was again a very good attendance and several new members were elected. Mr. G. W. Fairall was elected Vice-Chairman, and Mr. Douglas Baker was elected to take his place on the Committee.

During the evening one of the members Mr. H. Taylor, **2KQ**, was tuned in as he was turning out gramophone music. Mr. G. W. Jones, afterwards gave a few hints and tips on the best methods of receiving telephony, and all were interested. Proceedings terminated at 10.30 p.m. Everyone is looking forward with great interest to future meetings, which will be held every week, on Wednesday evenings at 7.30 p.m.

The Hon. Secretary, Mr. Geo. W. Jones, will welcome any applications for membership at 8, Roseberry Street, or at the Headquarters, 26, King Street, Wolverhampton.

### The Wallasey Wireless and Experimental Society.

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, New Brighton.

The Society held their seventh evening meeting on Thursday last, at 106, Albion Street, Mr. J. C. Mason in the chair.

The first half of the meeting was principally business, and an excellent syllabus for the coming session was arranged.

The remaining time was taken up by general discussions, many questions being asked and ably answered by the members. Affiliation with London is being arranged.

### Grimsby and District Radio Society.

An efficient and comfortable Club-room has now been secured by the above Society. On March 7th a meeting was held, there being 21 members present; Mr. Hewins (President) Mr. Rushton and Mr. Wood (Vice-Presidents) all demonstrated their apparatus, and an enjoyable evening was spent by all.

Meetings will be held each Tuesday evening from 7 p.m. to 10.30 p.m. in the Club-room at The Lincolnshire Motor and Electric Traction Co.'s Offices, Wellowgate.

Hon. Secretary, Mr. J. H. Perkins, 35, Hare Street, Grimsby.

### Richmond and Kew Wireless Society.

The above Society has now been formed, and meetings are held at 3, Lonsdale Mews, Sandycombe Road, near Kew Gardens Station.

During the last two meetings the following have been elected:—President, Mr. H. Lloyd; Vice-President, Mr. T. Golding; Secretary and Treasurer, Mr. A. J. Richardson; Assistant Secretary and Treasurer, Mr. P. Kendrick.

Already an aerial has been erected and a complete set of instruments installed.

Correspondence and applications for membership should be addressed to the Hon. Secretary, 14, Forest Road, Kew.

### Ipswich and District Wireless Club.

It is with the deepest regret we have to chronicle the death, on January 29th, of Mr. W. C. Firman, of our Committee, and one of the oldest pre-war amateurs in the district. A letter of condolence was sent and our Treasurer (Mr. Keeble) represented the Club at the funeral. A wreath was also sent by members of the Club.

Our local Member of Parliament (Sir F. J. C. Ganzoni) has kindly consented to become First President of the Society. The Club set is now working and buzzer practice is indulged in every Monday night for a short period.

### Ealing.

Mr. W. F. Clark, 52, Uxbridge Road, Ealing, W.5., will be pleased to hear from any gentlemen willing to help form a Wireless Society for Ealing.

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**Note.**—In bringing reports up to date, owing to the change from fortnightly to weekly issue, it is regretted that it has been necessary to considerably curtail many of the reports in order that future reports may receive prompt publication. [ED.]

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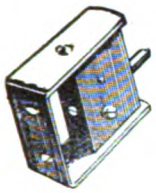

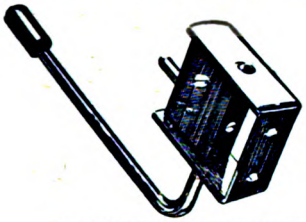

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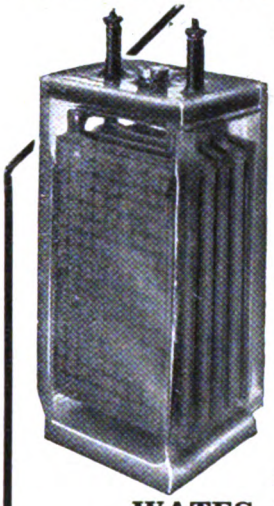

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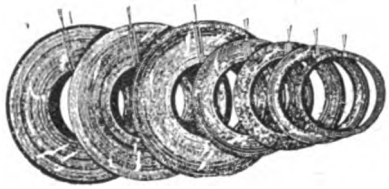

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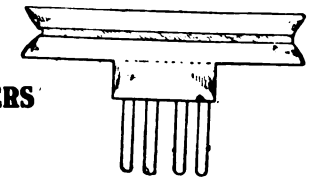

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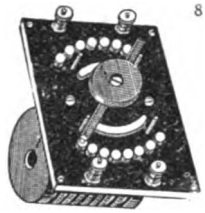

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only.* (2) *Queries should be clear and concise.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *Four questions is the maximum which will be accepted at a time.*

**"NOVICE" (Edinburgh)** *asks questions about a single valve receiver.*

(1) Connections are all correct. There is no need to use No. 47 wire for external connections to H.T. and telephones. Use any convenient wire a good deal coarser than this. The condenser capacities are correct.

(2) If the reaction coupling is strong enough a parallel condenser of about 0·0008 mfds. may be used with the aerial condenser shown without a great loss of efficiency.

(3) The reaction coil should be placed against the A.T.I. coil. There will be no coupling in the way you propose.

(4) We are afraid you will not hear either of these stations owing to the great distance.

**F.N. (Oldham).**—(1) The circuit is correct, except that the blocking condenser should be connected across both H.T. and telephones: 0·006 mfds. is rather a large value.

(2) Yes.

(3) With an indoor aerial there is not much choice, except to have as much wire as possible without allowing one length to turn back on another so as to balance out any signal induced in it.

(4) A 2½" former, 10" long, full of No. 28, should be a suitable reaction coil.

**A.P.S. (Cape Town)** *asks for details of chokes for a set as described on page* 533, *November 26th issue.*

We are sorry that we have no information regarding this circuit beyond that given in the article in question. Chokes of this sort are best determined by experiment.

**R.K.C. (Liverpool)** *asks* (1) *The identity of the telephony station sending during the afternoon on about* 2,000 *ms.—apparently in French.* (2) *For the best* 3*-valve circuit for telephony.*

(1) This station may be FL (Paris) who sends daily on 2,600 ms. There is, however, a new station sending music on about 1,900 ms. who is at present unknown to us.

(2) The best circuit to use is a H.F. amplifier with either resistance or a transformer coupling between the valves.

**A.T.N. (Croydon)** *asks* (1) *If it matters if two wires of the aerial are not of the same gauge.* (2) *What wire to use for leading-in.* (3) *for a single valve diagram.* (4) *The range of his set.*

(1) It is immaterial.

(2) Use the same wire as for the aerial, without a break in it if possible.

(3) See page 584, Fig. 2, December 10th issue, omitting the condenser across the anode inductance.

(4) The maximum wavelength will be about 3,500 ms.

**G.F. (Walworth)** *asks* (1) *For criticism of a crystal set.* (2) *For dimensions for a frame aerial to use with it.* (3) *If the circuit is incorrect, for a better one.* (4) *If a telephone transformer is necessary with L.R. telephones.*

(1) The circuit shown is correct, and the dimensions of the parts are also right.

(2) A frame aerial is entirely useless with a crystal set.

(4) Yes, a telephone transformer is desirable with nearly all crystals.

**"NEMO" (Wilts)** *has a resistance amplifier which gives disappointing results, although each part of the circuit except the grid condensers and leaks appears to work well when used in other ways. He asks for suggestions.*

0·001 mfds. is large for a grid condenser, try about 0·0001 mfds. Your resistances may be faulty. Some of the grid leaks on the market are of very doubtful accuracy and permanence. Try removing the leaks. If this improves results, either the leaks are too low, or the condensers themselves are leaky. Possibly you are not using enough H.T. volts. A valve used in this way requires greater H.T. than when used in any other way.

**L.H.B. (Luton)** *asks for a diagram of the connections of a valve panel, containing filament res., grid condenser and leak.*

See diagram Fig. 1 for a panel for single-valve work.

**"GRID" (Brighton)** *asks for particulars of winding of a set of slab coils for a range of* 300-30,000 *ms.*

See reply to **W.H.D. (Leeds)** above. The amounts of wire required will be approximately the same for slab coils as for duo-laterals.

**"AEROLUS" (Whitefield)** *asks* (1) *Which is the better of two sets described.* (2) *Where he can obtain "watersheds" for aerial insulators.*

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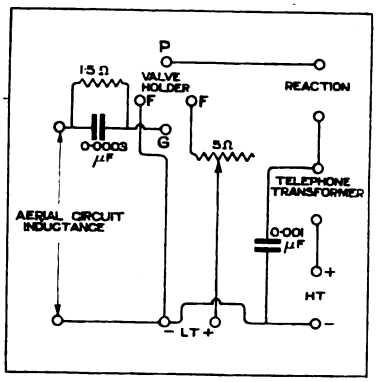


*Fig.* 1.

(1) You do not give sufficient particulars to make an accurate estimate.

(2) Inverted cone watersheds of the type you sketch should be obtainable from almost any dealer in wireless sundries. Amongst other firms, the Marconi Company make a good type.

**F.T. (Birmingham)** *asks* (1) *Whether certain stations will be audible on a single valve set.* (2) *Winding for an A.T.I., using No.* 27 *wire, to give* 7,000 *ms., with a parallel condenser of* 0·0005 *mfds.* (3) *If a crystal set sketched will be satisfactory.* (4) *The names of the following spark stations:* **CO** and **MO.**

(1) The stations referred to are Belgrade, Vienna, Sofia, and Moscow. It is possible to receive all of these stations on a very good single valve set, skilfully handled, but they are not at all easy to get with a set of this type.

(2) 10″ × 7″.

(3) No, put the telephones in series with the condenser.

(4) We have no information.

**"AMATEUR" (Newcastle)** *asks* (1) *Whether it would be better to use an aerial condenser of* 0·001 *or* 0·0015 *mfds., with honeycomb coils.* (2) *If it is possible to receive the Dutch concert with a* 2*-valve L.F. amplifier.* (3) *If a* 0·0006 *mfds. condenser will be of any use across a reaction coil.*

(1) This depends to a certain extent on the windings of the coils, about which you say nothing. In general, however, it will not make much difference.

(2) We do not think so.

(3) No.

**A.C. (Bexhill)** *asks* (1) *Who transmitted the tune "I want to go home," with various other tunes on Sunday (which Sunday is not specified) about* 3.30 *p.m.* (2) *What was the wavelength.* (3) *Will they do it again.*

(1), (2) and (3) We do not know. In general it is quite impossible to answer questions of this nature.

**G.H.M. (Anfield)** *sends a diagram of a* 3*-valve set, which will not give telephony on about* 400 *ms., gives fair results on longer wavelengths, but does not give* **PCGG.** *He asks for criticism and advice.*

Valves are arranged as detector followed by 2 L.F. This alone is sufficient to explain why you do not get **PCGG,** for which you would want at least one stage of H.F. For short waves do away with the parallel A.T.C. The probable reason for your not getting short wave signals is that your aerial is not tunable to the short wavelengths. We cannot say for certain as you give no particulars.

**S.C.P. (Derby)** *asks* (1) *Whether a Weston relay, sensitive to* 50 *microamps. could be used in conjunction with the Turner relay circuit.* (2) *Whether a* 2*-valve resistance amplifier could be used with the above to work a siphon recorder.* (3) *If not, for a suitable circuit for* 2 *valves.*

(1) Yes, but a somewhat coarser type of relay may be used instead if you wish. The Turner circuit gives enough current to work a P.O. type relay at reasonable speeds, and this type of relay is generally less liable to get out of order and give trouble.

(2) & (3) The suggested circuit will be as good as any for fairly long wavelengths, but we should prefer the tuned transformer type at short wavelengths.

**W.H.D. (Leeds)** *asks* (1) *For the amount of No.* 26 *D.C.C. necessary to make duolateral coils for a single valve receiver ranging up to* 30,000 *ms.* (2) *How to connect up the coils to a multiple switch so that they may be used alternatively.*

(1) With a parallel condenser of 0·002 mfds., you will require for the largest coil about 1¼ lbs., which will give a coil of 4″ mean diameter and about 1,200 turns. The other coil should be intermediate between this and about 1 oz.

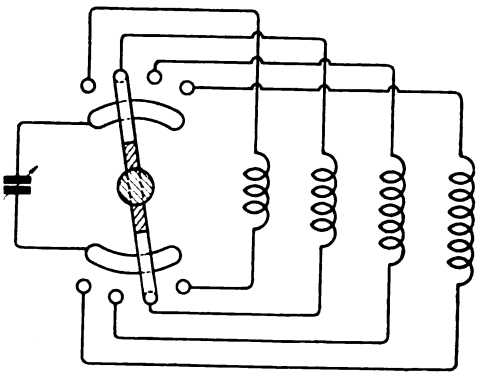

*Fig.* 2.

(2) A switch can be arranged as in the diagram Fig. 2, but we do not recommend it. It is better to connect each coil into the circuit as required. This can be done almost as easily as switching if suitable plug connections are used.

**H.S.W. (Leytonstone)** *asks various questions about a receiving set.*

(1) The general arrangements will be all right, but it will not be necessary to make such elaborate tuning arrangements for the reaction coil. A single coil with a few tappings without dead end switches will be all right for this, and do **not use** a condenser across it.

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 2. APRIL 8TH, 1922. WEEKLY

## The Beverage Antenna

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

IN the recent short wave Transatlantic Tests during which the representative of the American Radio Relay League—Mr. Godley—listened in at Ardrossan, near Glasgow, he employed not an ordinary form of aerial, but what is usually termed a "Beverage Antenna."* From the description of his experiences, as published in *The Wireless World* for February 4th, 1921, it may be noted that this antenna consists of a long low horizontal wire stretched out on short poles in the direction of the incoming signals. In the actual arrangement used by Godley this wire was supported on poles 12 ft. high, and was at first 1,350 ft. long, but was afterwards reduced to about 850 ft. For the signals on 200 metres wavelength, however, it will be noted that this length is nearly 50 per cent. more than one complete wavelength, so that although the wire was connected to earth at both ends it was evidently not functioning in the manner of an ordinary loop aerial (even of exaggerated size) such as one might at first be led to expect. The fact that one of these earth connections was made through a resistance of several hundred ohms, also disposes of this idea, since the presence of such a large resistance in an oscillation circuit would be very detrimental to its proper functioning.

In what manner, then, does the arrangement work, and in what respects does it differ from an ordinary type of aerial?

To investigate this point it may be of interest to consider the arrangement more in detail. From its great length in comparison with the height of the wire above the ground, it resembles in many respects an ordinary form of overhead telephone line, and hence it is not unreasonable to suppose that the theory of the propagation of electric impulses along telephone lines, should apply also to this case. The complete theory of the propagation of currents and electric impulses along a telephone line is very complex, but fortunately the large quantities introduced into some of the terms in the formulæ when the frequency is very high enable simplifying assumptions to be made. When an electric impulse is applied to such a line a wave will be propagated along it with a velocity which is a complex function of the electrical constants of the line, of the form of

$$V' = \frac{2\pi f}{\sqrt{\frac{1}{2}\left\{\sqrt{(R^2 + 4\pi^2 f^2 L^2)(S^2 + 4\pi^2 f^2 C^2)} - (SR - 4\pi^2 f^2 LC)\right\}}}$$

where $f$ = frequency of the currents
$R$ = resistance of the line per unit length.
$S$ = leakance of the line per unit length.
$L$ = inductance of the line per unit length.
$C$ = capacity of the line per unit length.

When the frequency $f$ is large as in the case of radio signals, the terms involving $R$ and $S$ become negligible compared with the $L$ and $C$ terms, so that the velocity of propagation then depends almost entirely upon the latter pair of line constants. For these high radio frequencies, the velocity $V$ becomes very close to the velocity of light ($3 \times 10^8$ metres per second) but is almost always slightly less than that limiting velocity.

When now a radio signal reaches a wire like the Beverage Antenna, which is stretched out in the direction of propagation of the wave, it will induce an impulse in the wire which will be propagated along the wire with a velocity determined by the electrical constants of the wire as just pointed out. Since the wave along the wire travels slower than the free wave in space, the impulse propagated along the wire will lag behind the electrical forces in the wave outside the wire and will absorb energy from the wave. The intensity of the electrical disturbance in the wire will therefore increase with the distance along the wire. Since the two velocities are different the lag between the wave on the wire and the free wave will increase the further we go along the wire, so that obviously a point will be reached when the phase difference between the two reaches as much as 90° or even 180°. When this occurs any further energy which passes into the wire from the free wave will be in the wrong direction to assist the growth of the impulse, and

* The essential features of this antenna are covered by U.S. Patent No. 1381089.

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the resultant effect will then begin to decrease again. Obviously, then, when this occurs, and if the receiving apparatus is to utilise the impulse established in the line, no useful purpose will be served in increasing the length of the line beyond a certain amount.

In the case of an ordinary loop aerial, this maximum effective length is obviously one-half wavelength, since there the phase difference between the two ends of the loop is utilised, but with the Beverage Antenna functioning in the manner just described the length of wire for maximum effect may exceed a complete wavelength, and may often be as much as two or three wavelengths. The greater the difference between the velocities of the wave on the wire and the free wave outside it, the shorter must be the wire in order that the maximum effect may not be passed, and the less the difference of wave velocities the greater can be the length of wire, and consequently a greater effect can be obtained on the receiving apparatus. These differences are illustrated diagrammatically in Fig. 1, which shows the building up of the wave intensity on the wire, (A) when the velocity difference is small; and (B) when it is much greater.

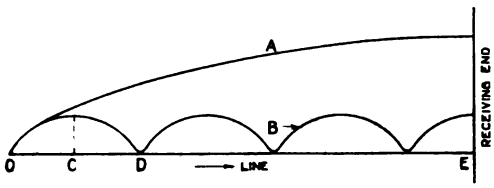


*Fig.* 1.

It will be noted from the foregoing that the impulse builds up on the wire *in the direction of propagation of the wave*, and that consequently the "free" end of the antenna, remote from the receiving apparatus, must point *towards* the transmitting station, and not away from it as in the case of ordinary bent or inverted **L** aerials. The curves in Fig. 1 may also be taken as representing the signal strengths that would be obtained in a receiving apparatus in the two cases, if the apparatus was gradually moved along the wire from the end O. In case (B), therefore, no advantage is gained by increasing the length of the aerial wire beyond that required to give the first maximum of signal strength, *i.e.*, beyond the length OC, but in case (A) the longer aerial is obviously advantageous.

If we remember that, as pointed out above, the falling off of signal strength that occurs when the wire length is increased from OC to OD (case B) or that would be obtained in case (A) if the length were made greater than OE, is due to the interference set up between the free wave in the space surrounding the wire and the wave propagated along the wire itself, it is evidently possible to make an estimate of the most useful length of aerial wire for any given signal wavelength and difference of velocities. For example, in the case of a signal of 200 metres wavelength, and a wave velocity along the wire of $2{\cdot}65 \times 10^8$ metres per second, the free wave velocity being $3{\cdot}0 \times 10^8$ metres per second, we should expect interference between the two to occur for a length of wire of about 3,000 ft., so that no useful purpose would be served in increasing the wire length in this case beyond 1,400 to 1,500 ft. Now the inductance per km length of a telephone wire of similar type to the aerial used by Godley at Ardrossan would be of the order of about 2·45 millihenries, and to obtain a wave velocity on the wire of $2{\cdot}65 \times 10^8$ metres per second as assumed above, would require that the wire have a capacity per kilometre length of about 0·0058 microfarad—a not unreasonable figure, considering the additional capacity that is unavoidable at each supporting pole.

These rough figures therefore indicate an approximate theoretical basis for the size of aerial used during the Tests.

Now, when a wave is propagated along a wire, and reaches the end of the wire, reflection of the wave will take place, and interference may occur between the initial and the reflected waves, with the production of a stationary or standing wave on the wire. This condition is evidently undesirable from the point of view of the proper operation of this antenna, and means must therefore be taken to eliminate, or at least to reduce this reflection.

Every line, such as we have been considering possesses what is known as a natural impedance or as a surge impedance, which expresses the effect exercised by the line upon a wave travelling along it. Since the energy of a travelling wave such as we are considering, is oscillatory in character, the energy may be regarded as being wholly magnetic at one instant, and later on as being wholly electrostatic, and as oscillating periodically between these two states. Assuming for the moment that the resistance losses in the line are negligible, the maximum magnetic energy will equal the maximum electrostatic energy, or $\frac{1}{2}LI^2 = \frac{1}{2}CV^2$ where $I$ = the maximum current, and $V$ = the maximum voltage, the quantities $L$ and $C$ being the same as already assigned to those symbols, above. Hence, we may write

$$\frac{V}{I} = \sqrt{\frac{L}{C}} = Z_0$$

The ratio $V/I$, which is the ratio of the maximum voltage to the maximum current in the travelling wave, has the dimensions of an impedance, and therefore this quantity $Z_0 = \sqrt{\frac{L}{C}}$ is termed the *natural impedance*, or the *surge impedance* of the line.

When an abrupt change is made in the electrical constants of a line at any point along it, the value of this natural impedance of the line $Z_0$ will usually be changed. This means that on each side of the point of change, the ratio of the maximum voltage to the maximum current in the wave must also have a different value, and consequently reflection of some of the wave energy will take place in passing across the transition point. If, therefore, in passing from a line, such as we have been considering, to some connected terminal apparatus, there is no change made in the natural or surge impedance no reflection of the wave will occur, but if, as is often the case, the apparatus connected to the line offers a different impedance to that of the line, then reflection will take place, and some of the available wave energy will be wasted.

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For this reason, then, in the Beverage Antenna, arrangements are made to ensure that the apparatus connected to the line at each end offers the same impedance to the wave as the line itself. Reflection of the wave energy will then be reduced to a minimum. The surge impedance of a line having the constants quoted above works out at about 650 ohms. The value of the earthing resistance used by Godley on his line varied between about 250 and 400 ohms—so that the above rough calculations at least indicate the right order of magnitude for this resistance. Actually, he used the aerial over a band of wavelengths between about 200 and 375 metres, so that the resistance used was not a fixed one, but needed to be varied occasionaly to get the best working adjustments.

The adjustment of the aerial for the reception of different wavelengths is not done by tuning in the ordinary way—the only circuit tuned to the wavelength of the incoming signal being the closed circuit of the receiver coupled to the aerial. Adjustment of the earthing resistance and of the inductance coupling the aerial to the receiver is also necessary in order to secure the proper functioning of the aerial in the manner outlined above, when the wavelength is changed. If this is not done, reflections of the energy may take place, and loss of signal strength will then result. If, however, the resistance of the earth connection itself is large, or the resistance or leakage losses in the wire itself are high, there will be less tendency for the reflection of the wave, and less care will be necessary in adjusting the terminal constants of the line. Such additional losses, however, are likely to cause loss of signal strength as compared with what is obtainable with a low-resistance well-insulated wire.

# Concerning Patents

THE POST-WAR POSITION.

MANY important changes in the normal procedure of securing the protection of Letters Patent for invention necessarily came into being with the outbreak of war. These were originally intended to remain in force until six months after the official ending of hostilities, but actually they were prolonged by subsequent legislation until January 10th, 1921, a period of nearly six and a half years.

The result is that even at the present time, the situation presents many difficulties, both to the inventor who has obtained a patent grant, and to persons who may be anxious to know how they stand with regard to possible infringement of the rights of others.

It is proposed therefore to set out briefly the more important consequences of the changes referred to, with the object of throwing some light on the general position.

The present state of affairs arises from two principal causes:—Firstly, the war emergency measures which were passed at the very outbreak of the war. Secondly, the special legislation that was enacted, after the Armistice, in order to give effect to the provisions of the Treaty of Peace, so far as they related to matters affecting the patent rights of the nationals of the several contracting countries.

*War Legislation.*

It is well known that normally it is necessary to carry out the various stages in the procedure of applying for, and maintaining patent rights, in strict accordance with the specific times laid down in the Patent Acts.

For example, once a provisional application has been filed, the complete specification must be lodged not later than nine months afterwards (1919 Act). By paying an extension fee an additional month is allowed; otherwise the application is dead. Again, in the case where a complete specification is filed in the first instance, there is now an extreme limit of eighteen months within which either the application must be accepted, or it is lost.

Similarly where the holder of a patent has neglected to pay the renewal fees within the stipulated time, his grant is forfeited—unless he is prepared to initiate expensive and troublesome proceedings to obtain a restoration. Even should he be successful in these proceedings, the patent is only revived subject to drastic restrictions.

The upshot of the early war emergency legislation was largely to nullify these time limitations, by giving power to the Comptroller-General of Patents to extend "the times prescribed for doing any act or filing any document" in any case where the applicant or patentee concerned was prevented from complying with the normal procedure by "any circumstances arising from the war."

These extensions were granted in a liberal spirit, not only to British applicants, but also to inventors in allied and neutral countries. As previously stated, such extensions could be granted at any time up to January 10th, 1921, so that, in an extreme case, a complete specification which should have followed up a provisional application lodged some six months (1907 Act) before August, 1914, need only have been actually filed in January, 1921.

Taking into account the necessary time for examination and acceptance of such an application, the invention would probably not be made known to the public generally until towards the end of 1921.

The result might easily prove something of a bombshell to manufacturers or innocent users,

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say, of an improvement in wireless apparatus, who in face of a patent bearing an effective date early in 1913 might find themselves in danger of an action for infringement unless they promptly ceased to make or use the protected device. (It is hardly necessary, perhaps, to add that in no case can an action be taken for infringement of a patent whatever the original date of the application until the actual patent has been accepted, published and sealed.)

An even greater lapse of time might occur between an application and the grant of the relative patent in the case of applications made from abroad under what is known as the International Convention; but this point will be dealt with later, in considering the effects of the Peace Treaty.

Another important result of the "extension of time" powers is to be seen in its application to the revival or restoration of patent rights.

Take the case of the holder of valuable patent rights granted prior to the war. Owing to the general slump in trade, or to any other cause directly attributable to war conditions, the patentee may have found himself unable to pay the necessary fees at the stipulated time. His rights, in consequence, would lapse; and some astute manufacturer in happier circumstances than the inventor may have seized the opportunity to exploit the article in his own interests.

In such a case, the original holder, by making application, could have his patent restored practically "as a matter of right," and the intruder would at once be forced to abandon further manufacture under the penalties of infringement. He would have no claim whatever to compensation from the restored patentee (as he would in the case of the normal pre-war procedure for restoration) in respect of any money he might have expended on erecting plant, or for time and labour spent in exploiting the invention.

*Peace Treaty Legislation.*

Under the provisions of the Act which gave the force of law to those sections of the Treaty of Peace which concern the patent rights of the subjects of the several contracting nations, a period of six months after the end of the war (subsequently extended until January 10th, 1921) was allowed to both allied and enemy nationals within which they could file patent applications in this country under the terms of the International Convention.

In effect this means that an allied or enemy inventor who had secured a patent grant in his own country at any time within a period starting twelve months prior to the commencement of the war and ending in January, 1921, could apply for protection in this country for the same invention, and obtain an effective date of priority coinciding with that of the foreign patent. As may easily be imagined the resulting inflow of foreign invention which had accumulated during a period of seven and a half years was enormous. In a large number of such cases the patent grant has only quite recently been sealed, and in a few cases is still outstanding, though in the course of the next month or so the process will be completed.

America was not a signatory to the Treaty, but, in effect, citizens of the United States were granted similar privileges under the powers of the war emergency measure.

An important distinction was, however, drawn between the patent rights given in such cases (including American applications) and the complete monopoly grant normally issued to an inventor.

The Peace Treaty definitely provided that such "post-dated" patents should not prejudicially affect the rights of persons here who were already, on or before January 10th, 1921, "*bona fide* in possession of the same invention."

In other words, supposing a British subject to have patented, or even merely to have manufactured or used, a certain device prior to the date above mentioned, then even in the face of a convention patent under the Peace Treaty dating back to the year 1913, he can continue to manufacture or use the device in question *personally* without fear of infringement proceedings on the part of the foreign patentee. Further, suppose he had taken out a British patent for the same invention (but bearing a date later than the effective date of the original foreign patent) and he had prior to January 10th, 1921, issued licences to other persons under his patent, such persons or licensees would also be immune from the penalties for infringement.

This, at all events, is the *prima facie* interpretation of the safeguarding clause relating to "persons *bona fide* in possession of an invention"; but it must be added that the point has not yet been fully dealt with by the Courts, and it remains to be seen exactly what meaning will be imparted to the expression when the matter comes under full judicial consideration.

*Enemy Patents.*

Finally, it should be mentioned that all patent grants issued to enemy subjects before the war (and for a short period during the war) were subsequently vested in the Public Trustee.

They were ultimately restored to their owners in 1920 under certain restrictions regarding the allocation of any money obtained either by their sale, or in respect of licences issued in respect of them.

Apart from these restrictions, restored enemy patentees may now sue for infringement committed either *before* the war, or *after* the date of restoration. It is probable, however, that any damages so recovered would be claimed by the Clearing Office as a pledge against the enemy reparation debt.

The general limitations imposed upon enemy-held patents apply equally to patents held by any limited company the directorate or control of which was mainly in the hands of enemy subjects, even if the Company itself was actually registered in this country.

M.A.L.

## Summer Time for Amateur Transmissions.

In reply to a letter addressed to the Postmaster-General, we are notified that, unless otherwise stated in the permit concerned, the hours for transmission allotted to amateur experimenters refer to Summer Time during the period when such time is in operation, and to Greenwich Time at other periods of the year.

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# Discussion on Methods of Amplification*

**Mr. C. F. Phillips.**

I am glad we have called this a discussion, as it is no sense a lecture and it would not be quite fair to call it a lecture. My idea in choosing this particular subject was to set out some form of amplifying receiver that anybody could make. We have had quite a number of lectures on scientific subjects of very great interest, but perhaps we ought not to forget that we are an amateur society and sometimes it is as well to talk about things that some of us less technical amateurs really understand.

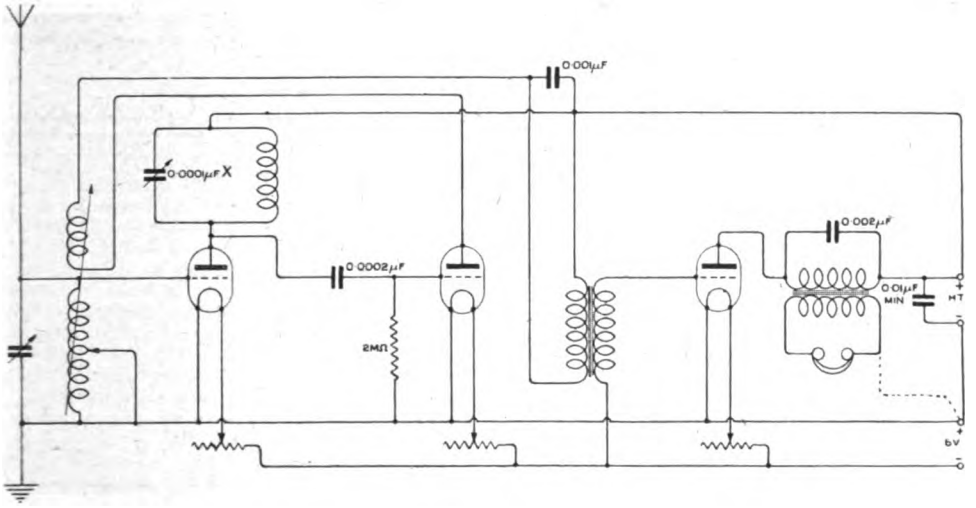


*Fig.* 1.

Now I think that most amateurs are more interested in the manufacture of their own apparatus than in anything else, so without any further delay I propose to describe a little three valve amplifier which can easily be extended into a five or seven valve amplifier and regarding which I propose to give data and my reasons for the selection of the particular methods I use as being preferable to other methods of attaining the same results.

In Fig. 1 we have three valves, viz. :—A radio frequency amplifier, a detector and a note magnifier. I want to draw your attention to the method of using the high frequency valve. I have something to say about both the grid and the plate, but we will deal with the plate first. There are three well-known methods of radio frequency amplification : the first consists in introducing a resistance between the positive side of the high tension battery and the plate in order that an alternating potential may be built up across it and impressed upon the next grid ; that system will not work with short waves for reasons into which I will not enter for the moment. Another system which is extremely well known is to connect the plate of the high-frequency valve to the grid of the next valve through a transformer. That system is illustrated in Fig. 2. The third system, which I personally prefer, is very similar to the resistance coupling described above but instead of a high resistance you use a reactance coil. As shown in Fig. 3, the reactance coil is connected in much the same manner as the primary (or input side) of the high frequency transformer. Now I have always contended that ordinary high frequency transformers do not transform. I do not think they do at all. I am not going to say that *no* radio frequency transformers actually transform ; if the two windings of the transformer are sufficiently far apart for the capacity between windings to be negligible, then the e.m.f. in the input winding will set up e.m.f.'s in the secondary by reason of mutual induction, but such transformers take up a great deal of space and are too cumbersome to build into sets. Commercially available transformers are never made in the above manner, and we have to come back to the type of transformer in which the two windings are placed one on the top of the other, or side by side in slots ; in either case the coupling between them is very tight indeed. Look at Fig. 2 and imagine that the two windings are placed one over the other very close together ; it seems to me that a potential created across the primary winding will not induce a potential across the secondary because the several turns of the primary are coupled by capacity to the several turns of the secondary by reason of their proximity ; such intermediate capacitive coupling lowers the effective potential induced from coil to coil and can be likened to a tapped potentiometer effect. All that happens is that there is so much capacity between winding and winding that the potential across the primary is transferred to the next grid by capacity, and very imperfect capacity at that. Why not

* A Discussion before The Wireless Society of London, opened by Mr. C. F. Phillips on Tuesday, February 28th, 1922.

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substitute a properly insulated condenser for the relatively poorly insulated capacity between windings ?

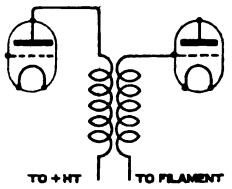


*Fig.* 2.

We will now deal with functions of the reactance coil shown in Fig. 3. Turning again to Fig. 1 the position of the coil in the circuit is indicated by the letter X ; it will be noticed that the coil is shown in parallel with a variable condenser, such a combination of inductance and capacity being known as a " Rejector Circuit." It is apparent that the function of the condenser is to *tune* the inductance to a particular wavelength ; when this circuit " X " is *tuned* to some wavelength, it will be found to possess a theoretically infinite resistance to alternating currents of a frequency corresponding to that wavelength ; that is why the circuit is termed a " Rejector," *i.e.*, currents of the particular frequency cannot get through. We now see that my circuit operates in a very similar manner to resistance

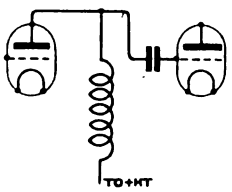


*Fig.* 3.

capacity coupling, and that the " Rejector " simply takes the place of the resistance. The resistance (or more properly, the " impedance ") of the tuned rejector may be of the order of several 100,000 ohms to the frequency of the wavelength which it is desired to receive and therefore the largest possible P.D. will be set up across it, and transferred through the coupling condenser to the next grid. At the same time the direct current resistance of the inductance coil of the rejector is only a few ohms and so there is a low resistance path to the plate for the direct current supply from the H.T. battery ; this is a great advantage over resistance coupling as it allows a lower voltage H.T. battery to be used with a corresponding reduction of extraneous noises. The method I have described is known as " Reactance-Capacity " coupling, and is very efficient even for wavelengths as short as 100 metres, as also of course for the longest waves now in use. In practice in making up this rejector circuit it is possible commercially to buy tapped inductances and various other things of that nature which should perform the function quite well. I should not advise the amateur to try to make them if he wants to use them for short waves. The adjustment is extremely critical and the omission of a few turns may make all the difference to signals. I have found that a very simple way of providing that inductance is to use one of the multilayer coils on the market. The De Forest, Burndept and Igranic coils are all equally suitable and as they are mounted on plugs of similar gauge they are quite convenient ; a plug should be screwed to the valve panel and connected as shown in Fig. 1, when any of the above coils can easily be plugged in. I give tables showing the inductance and capacity of these various makes of coils and for what band of wavelengths they are suitable when used as reactances. (See tables in Figs. 4 and 5*.) Just to give you some slight idea, on 1,000 metres, a wave in which we are all interested, if we use

**Burndept Coils.**

| Coil No. | True Inductance Microhenries. | Distributed Capacity Micro-micro-farads. | λ in metres (as anode coils) used with 0·0001 condenser. | |
|---|---|---|---|---|
| | | | From | To |
| 25 | 77 | 32 | 160 | 230 |
| 50 | 148 | 39 | 220 | 320 |
| 75 | 330 | 36 | 300 | 450 |
| 100 | 587 | 30·5 | 400 | 550 |
| 150 | 1,200 | 26·5 | 600 | 900 |
| 200 | 2,360 | 24 | 850 | 1,300 |
| 300 | 4,860 | 20 | 1,200 | 1,800 |
| 400 | 10,200 | 17 | 1,700 | 2,800 |
| 500 | 21,700 | 17 | 2,400 | 4,000 |
| 750 | 52,000 | 18·5 | 3,800 | 6,500 |
| 1,000 | 108,300 | 16·3 | 6,000 | 10,000 |

1,000 coil for longer waves, 0·0035 for 15,000 m : 0·001 for 20,000 m

*Fig.* 4.

Igranic coils we should need a No. 200 ; if we use a Burndept we should also need a 200 and for a De Forest, a No. 250. On 200 metres we should want a No. 35 Igranic or a No. 25 Burndept ; I have not measured the De Forest.

As regards the small variable condenser shown across the reactance coil, that condenser should be as small as possible : there are reasons into which I have not time to enter, because we want to get the Marconi telephony. I have found in practice that a condenser for short wave work should not exceed 0.0001 mfds. I call 600 metres short wave working. For long wave work it can be as large as 0.0002 mfds. Every single micro-microfarad across the reactance coil puts its wavelength up by a very appreciable amount, and if my tables (Figs. 4 and 5) are to be relied upon it is essential that the zero capacity of the condenser be kept very low indeed. In my own set I use a Sullivan Self-Heterodyne Condenser, which has a zero capacity of about 6 $\mu\mu$F and a maximum of 100 $\mu\mu$F (0·0001 mfds.). I believe that it has the lowest zero capacity of any condenser on the market.

* Author's Note. I regret that I cannot give any table of De Forest Coils, as I have not been able to borrow a complete set for measurement. —F.P.

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**Igranic Coils.**

*(Also known as "North Eastern" coils, etc.)*

| Coil No. | True Inductance Microhenries. | Distributed Capacity Micro-micro-farads. | λ in metres (as anode coils) used with 0·0001 mfd. condenser. From | To |
|---|---|---|---|---|
| 25 | 37 | 32 | 110 | 170 |
| 35 | 65 | 36·5 | 150 | 220 |
| 50 | 135 | 45 | 210 | 300 |
| 75 | 290 | 40·5 | 290 | 400 |
| 100 | 520 | 36·5 | 390 | 650 |
| 150 | 1,190 | 31 | 600 | 900 |
| 200 | 2,160 | 32 | 850 | 1,200 |
| 250 | 3,370 | 29 | 1,050 | 1,500 |
| 300 | 4,900 | 25·5 | 1,300 | 1,900 |
| 400 | 9,000 | 23·5 | 1,700 | 2,800 |
| 500 | 14,470 | 22 | 2,100 | 3,300 |
| 600 | 19,700 | 23 | 2,500 | 4,200 |
| 750 | 31,130 | 22·5 | 3,700 | 6,000 |
| 1,000 | 57,820 | 20·5 | 4,000 | 7,000 |
| 1,250 | 94,500 | 21 | 6,000 | 9,000 |
| 1,500 | 138,675 | 23·5 | 7,500 | 12,000 |

1,500 coil for longer waves 0·0005 for 16,500 m ; 0·001 for 22,500 m.

*Fig. 5.*

Having finished with the plate, we will now turn to the grid. In the circuit given in Fig. 1 you will observe that the positive side of the low tension battery is connected to earth and, through the tuning inductance, to the grid of the first valve. That is rather unusual and at first sight seems ridiculous because you make the grid about 4 volts positive, and thus start up a large grid current of the order of about 3/10ths of a milliampere with a French R valve, or about 1/10th of a milliampere with a hard British R valve. Grid currents of this order mean that the impedance of grid to filament (*i.e.*, aerial to earth) has been lowered, and thus considerable damping of the signal takes place. Owing to the "damping," or more simply, the resistance of the circuit oscillations cannot persist and tend to die away quickly and thus the whole arrangement appears to be most inefficient and very absurd. That would certainly be the case were it not for the wonderful effect of regeneration as produced by the reaction coil. In my circuit, the reaction coil is connected between the detector plate and the H.T. battery and is coupled to the A.T.I. (or secondary coil in selective working). In the reaction coil amplified radio frequency oscillations are present which are exactly synchronised with the oscillations being impressed between the grid and filament of the first valve; these latter oscillations tend to die away rapidly owing to the grid current damping, but they are being reinforced continually by the oscillations in the reaction coil, the energy for which does *not* come from the aerial but from the H.T. battery. So in spite of grid damping, signals do not suffer, as the damping is neutralised by a slight additional current drawn from the H.T. battery. The reason for adopting this system, which by the way contrary to generally accepted opinion, does *not* introduce appreciable distortion in speech* is to obtain absolute stability of operation. Many of you may use radio frequency amplifiers with magnetic reaction, and if so, you will appreciate how easily such amplifiers fly into oscillation when least required and you often cannot control the degree of reaction at all. On the other hand, with positive grids you can use magnetic reaction from the detector plate to the first grid as easily and simply as in a single valve circuit. Thus in my circuit you have the advantage of high frequency amplification coupled with the very great advantage of completely controllable regeneration by magnetic reaction; that is to say by varying the coupling between grid coil and reaction coil you can increase regeneration until your set is just on the verge of oscillating when you get highest efficiency for spark or telephony, or by coupling more tightly you produce oscillations for autodyne reception of C.W. Now as regards the control of this first grid (see Fig. 6), I said that it was about 4 volts positive. It may be thought at first sight that the rheostat shown for the high frequency valve only controls the heat of filament; it does not, it very effectively controls the potential of the grid. The filament temperature of most modern hard valves is not a thing which matters very much, they are not very sensitive to temperature changes, not nearly so sensitive as they used to be. Looking at Fig. 6 we have a 6-volt battery, the positive side of which is connected to the filament and, through the tuning inductance, to the grid.

Denoting the positive end of the battery as +6 volts, and the negative end as 0 volts, the grid and one end of the filament are at +6 volts. The negative end of the battery is taken to the filament through a rheostat across which there is a drop of about 2 volts, therefore that end of the filament is at + 2 volts. From Fig. 6 the grid is + 6 volts and the most negative end of the filament + 2 volts, therefore the grid is 4 volts positive with respect to the most negative end of the filament. By varying this rheostat you can vary the potential of the grid but only so that it is more or less positive.

Now to deal with other details of the circuit; you will see that as we have a grid condenser between the first plate and second grid: although that condenser assists rectification, it is not otherwise a matter of much importance; it must be very well insulated as its function is to keep the positive H.T. off the grid of the second valve; its size (*i.e.*, capacity) is not important as long as it is large enough to pass freely the longest wavelength signals that you think you will get. It is quite all right if it is a lot too big for the short wave signals, provided that the size is not made so large that the charging time period would become appreciable. I have found 0·0002 or 0·0003 mfds. to be suitable for all-round use. The grid of the second valve must not be completely insulated or it will accumulate a negative charge; a grid leak is therefore required, but it cannot be connected across the condenser as that would connect the positive side of the H.T. battery to the grid, making it very positive. The leak must be connected to one of the filament leads and it really does not much matter to which. If you connect to the negative, the grid will be at zero potential, no grid current will be set up, and with no current flowing along the leak, there will be no drop of

* Author's Note.—The reason is obvious to my mind. With negative grids the H.F. valve is being worked practically on the bend of its curve and may rectify when it should amplify *only* . . . re-rectification by the detector valve would then produce distortion. With positive grids the valve works well up its curve and thus amplifies *only*.— F.P.

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potential. Curiously enough if you connect the leak to the positive lead almost the same thing will

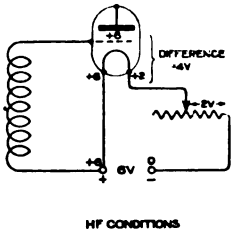


*Fig.* 6.

apply, and the grid will still be only a fraction of a volt more positive than it was before: the explanation is that the grid would *tend* to go 4 volts positive, *but* that would set up a grid current of some 200 microamperes; now a leak of 2 megohms at a pressure of 4 volts, will pass only 2 microamperes, therefore practically the whole of the 4 volts are dropped across the leak and the grid potential is hardly moved from zero potential.

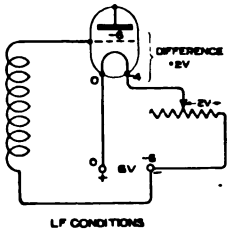


*Fig.* 7.

The third valve shown in the diagram is a low frequency amplifier more usually termed a "Note Magnifier." The connections are in accordance with standard practice and the only point of interest is the means adopted to give a slight negative bias to the grid, the desirability of which I will refer to later. In many circuits one or two dry cells are used in the grid-filament circuit to give the necessary bias, but they are a nuisance and there is a very simple manner of attaining the same end. In Fig. 7 you will see that the grid is connected, through the secondary of the inter-valve transformer, to the negative end of the filament battery; that end of the battery is connected to the filament through a rheostat across which there is a drop of, say, 2 volts; from the diagram it will be clear that the grid is 2 volts more negative than the most negative end of the filament, so we have attained our required negative bias. The reason for this bias is to prevent any grid current from starting and flowing through the secondary of the transformer, which might set up counter e.m.f.'s in the winding, opposing the e.m.f.'s transferred from the plate of the detector valve.

We will now deal with the various condensers used in the circuit. Condensers in wireless circuits can most conveniently be thought of as resistances (or more correctly "impedances"), and I am going to speak of them as such, but you must bear in mind that to *direct current* they are always of *infinite resistance*. There is a formula which gives the impedance of any condenser for any definite frequency. We need not cite the formula but you most probably know that the larger the condenser the lower is its resistance or impedance, the longer the wavelength the greater is the resistance of any definite condenser. The value of the grid condenser is 0·0002 mfds., which at 1,000 metres is equal to a resistance of 5,000 ohms, and at 10,000 metres to 50,000 ohms. It may seem that 50,000 ohms is a large resistance, but the alternative path for the oscillations is through the rejector (X in Fig. 1) which will have a "resistance" of many hundreds of thousands of ohms. The value of the condenser shown across the primary of the intervalve transformer is quite important, as that condenser performs a very delicate bit of "sorting out." It is given in the diagram as 0·001 mfds. The current flowing round from the plate of the detector, through the reaction coil and primary of the transformer to the H.T. battery, consists of two different components, which, however, are varying in exact phase one with the other; there is the radio frequency component which is flowing through the reaction coil to reinforce the incoming oscillations, and there is the rectified pulsating current of "note" frequency. We do not want to pass radio frequency current through the transformer at all, but we do want to pass the whole of the note frequency current through the transformer in order that it may be transferred to the grid of the third valve and so magnified. What we do is to place the primary of the transformer and a fixed condenser in parallel, and by proportioning the condenser properly we can make the condenser the easier path for the radio frequency component and the transformer winding the easier path for the note frequency component.

An average inductance value for the transformer winding is about 2 henries, and as inductances, like condensers, can also be thought of in terms of resistance (or impedance) varying with the frequency, the following table will make the matter quite clear.

IMPEDANCE IN OHMS.

| Wavelength or Frequency. | Of Winding 2 henries | Of Condenser ·001 |
|---|---|---|
| 1,000 metres } radio frequencies | *5,500,000 | 1,000 |
| 10,000 metres } | *550,000 | 10,000 |
| 1,000 cycles note frequency. | 19,000 | 150,000 |

The telephone transformer and its condenser do not require explanation; the function of the condenser being to improve the quality of the

*Theoretical value. Considerably less in practice owing to capacity between turns.

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note and to bye-pass any slight radio frequency component that might have got through the intervalve transformer. The best value of the condenser is usually about 0·002 mfds.

The condenser across the H.T. battery is not usually thought much of, but it is really very important that it should be as large as possible. You will notice that the circuit carrying radio frequency components from the plates of the first and second valves to their filaments runs through the H.T. battery, or rather it *would* run through that battery if it were not for the condenser across it. We do not want any resistance in that circuit or else we shall get potentials built up across it, and the battery may well have a fairly high resistance when old; also to prevent the radio frequency component flowing through the battery (and so perhaps interfering with tuning), we must select a condenser that has a resistance lower than the battery. The resistances of different condensers at two different frequencies are given below in ohms. :—

IMPEDANCE IN OHMS.

| | 1,000 metres. | 10,000 metres. |
|---|---|---|
| 0·001 mfds. | 1,000 | 10,000 |
| 0·01 ,, | 100 | 1,000 |
| 0·1 ,, | 10 | 100 |
| 1·0 ,, | 1 | 10 |

In my opinion 0·01 is the smallest condenser that should be used, and 0·1 or even 1 mfd. is evidently better if you can get it. Incidentally a paper condenser is quite suitable in this position, provided that you test it occasionally to make sure that there is no leakage which would run your H.T. battery down very quickly.

I am showing on the table a compact little set that I have had made up according to the principles I have put before you. A plug is provided for plugging in coils for the "rejector circuit," but I have omitted the note magnifier valve as I wished to connect it up to other apparatus in my possession.

**Capt. H. de A. Donisthorpe.**

It is an understood practice that any degree of amplification can be obtained providing sufficient valves are employed, but with each additional valve the cost of maintenance and running is increased. This is a fact which must appeal to quite a number of amateurs and a commercial company has introduced a four-electrode valve to overcome this difficulty and amplification is

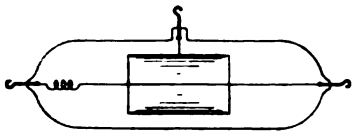

*Fig.* 1.

obtained using the four-electrode valve which is equal to three three-electrode valves, one as a high frequency amplifier, one as a rectifier and one as a low frequency amplifier.

It is not my intention to deal with this method of producing magnification of radio signals, but to deal with another method of attaining similar results and one which an amateur can experiment with on short wavelengths. The application of a magnetic field to the electronic flow of thermionic valves is a matter which at the present time is

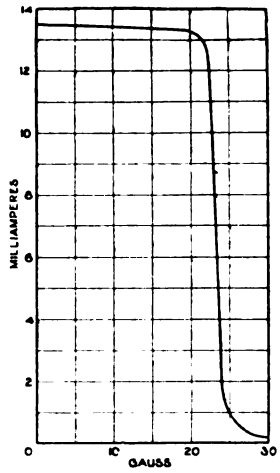


*Fig.* 2.

causing some considerable interest, and whereas Dr. Hull in America produced a hard valve where some interesting results are obtained by the exertion of an externally produced field, I personally, quite independently, have carried out some experiments in this connection with a circuit employing a soft valve, and one where the valve is subjected to a magnetic force with beneficial results.

In order to explain the magnetic device more clearly, I will briefly describe Dr. Hull's Magnetron (Fig. 1). It consists of a highly evacuated tube, an ordinary filament wire going right the way through, and an anode and a total absence in this case of a grid. Now if a milliammeter is connected in the anode circuit in the usual way, and the filament

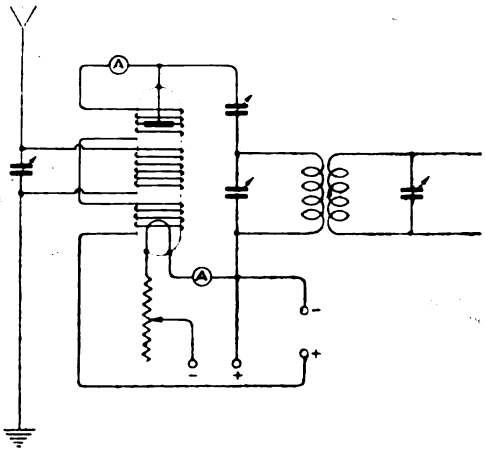


*Fig.* 3.

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brought to incandescent, an electronic flow will be set up and a current will be registered in milliamperes. If a current is made to pass through an external coil placed about the top of the tube an effect will be produced on the value of the anode current. Fig. 2 shows you the effect of plotting the anode current against the magnetic field. Starting with a minimum magnetic field and then slowly increasing it, a point will be arrived at where there is a sudden falling off in the value of filament anode current. Further increase in field strength results in a complete cutting off of the

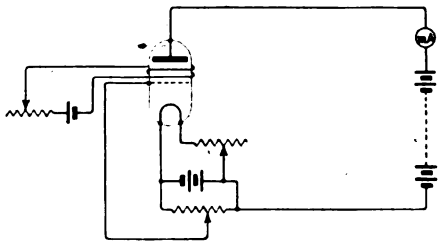

*Fig.* 4.

anode current. It will be seen that it is a very special curve and falls away at a point. The circuit shown in Fig. 3 is that which Dr. Hull employed in his "Magnetron" for amplifying signals. Here is the usual anode circuit and the coil across the

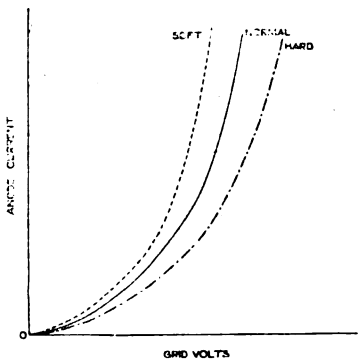


*Fig.* 5.

aerial condenser is placed around the Magnetron, and in addition there are two other coils arranged at each end of the tube which are rigged up with a battery for exerting the critical magnetic force on the valve. Oscillations in the aerial inductance produce fluctuations of the critical magnetic field, and signals are produced in the telephones of considerable magnitude as compared with those produced by an ordinary rectifying valve. This method can be carried on to a number of valves but one good valve (I, personally, have not used this circuit, so I cannot vouch entirely for its working), but the point that must be emphasised here is the fact that the magnetic field in the instance of a hard valve is made to decrease the electronic flow, while in the case of a soft valve a reverse action is produced, that is, there is an increase in the filament anode current as the magnetic field is increased.

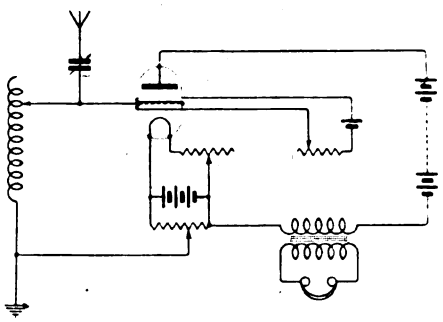

*Fig.* 6.

This illustrates the circuit which I myself am interested in. Fig. 4. Here is an ordinary three-electrode valve with plate connected to the H.T. battery and grid connected through a potentiometer to the filament. A coil for producing a magnetic field is supported over the valve and connected in series with a resistance and battery. If the ordinary characteristic curve of the valve without the magnetic field is plotted, and then plot a further curve with the magnetic field on, that is to say, having adjusted the current passing round the coil, results will be obtained you will see as shown in Fig. 5. It will be observed that in the case of the soft valve the anode current is increased while the anode current of the hard valve is decreased as explained earlier.

The application of this action in a receiving circuit is given in Fig. 6. It has an ordinary detector circuit, with aerial inductance and capacity arranged in the usual manner and potentiometer grid control. The potentiometer is adjusted to produce the best signals in the telephones. If then the magnetic field is applied, care being taken to adjust the position of the coil relative to the electronic flow and the value of current passing round the coil, both factors being rather critical, you will find that you get an increase in signal strength of about 100 per cent. About 300 ampere turns are required to produce the desired result. The interesting point which must be borne in mind here is that, whereas the actual negative electron flow is distorted and correspondingly weakened, yet the effect on the positive ions is sufficient to overcome this diminution and actually to increase the original filament anode current.

At this discussion there is not time to go into the matter fully, but it is advisable to just mention that in the case of the negative electrons, the magnetic field distorts their path, but in the case of the positive ions (which you see as a blue glow), they are set along the magnetic lines of force produced by the field. A rather pretty experiment in this connection is to blue the valve up by putting considerable high tension on the anode and then to exert the magnetic field near the top of the valve and notice how the position of blue glow changes its position.

Of course the magnification produced by the method just described is nothing like that given by the use of a large number of valves, but it opens up a field of research for amateurs. I hope that some of you will be able to try some experiments and let us know the results obtained.

*(To be continued.)*

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# A Tuner and Three-Valve Amplifier for all Wavelengths

BY PERCY W. HARRIS.

(*Concluded from page* 16.)

## WIRING UP.

The wiring looks very complicated—really much more complicated than it need be. The reason is that every wire is kept well away from every other wire, to avoid induction and capacity effects. This arrangement may look clumsy, but is fully justified, as the instrument is remarkably silent in action, there being no "non-wireless" noises whatever, even at fullest amplification.

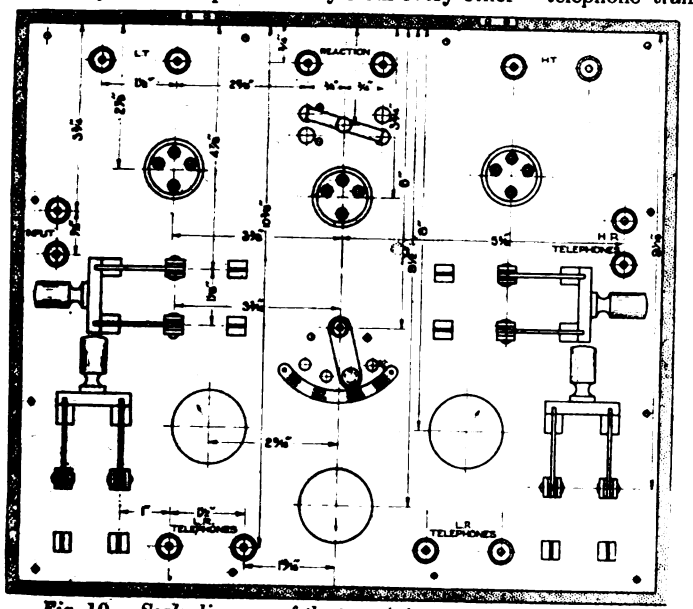


*Fig.* 10.—*Scale diagram of the top of the amplifier unit, with measurements. For photograph, see Fig.* 12.

Before any wires were connected, all connections were drawn out full size on the sheet of paper mentioned above. Coloured chalks for the various circuits are a help and save confusion. With this sheet as a guide, pieces of No. 18 tinned copper (this is stiff enough to hold up well) were cut and bent to shape and insulated tubing slipped over each wire before bending to its final shape. The longer leads present some difficulty in fitting the insulating tubing, owing to the tight fit, but no trouble will be experienced if the tubing is cut to lengths of about three inches, and slid on piece by piece. The point where the tubing joins is practically invisible. In a few cases, such as the wiring of the H.F. transformer switch, No. 22 wire was used.

In the particular instrument being described, yellow tubing is used for the filament circuits, green for grid circuits, and red for high-tension and plate circuits. Black is used for the telephone transformer primary connections. This arrangement looks neat and helps in subsequent tracing of circuits.

It is well to commence with the wiring of the input connections, making each lead to shape and then laying it by for later soldering. If the leads are made in one circuit at a time, nothing is likely to be overlooked. As leads are made they may be ticked off on the full-sized drawing.

Wherever possible, connections should be soldered. For this purpose a gas-heated soldering bit is a great convenience, for the temperature can be kept constant and connections very quickly made. The writer purchased such a tool after a whole evening struggling to solder but one or two connections with an ordinary bit, and thereafter the work became as child's play. One such is advertised in this magazine.

For the benefit of those who, like the writer, had had no previous experience in soldering such connections, it may be mentioned that the method adopted was to "tin" the

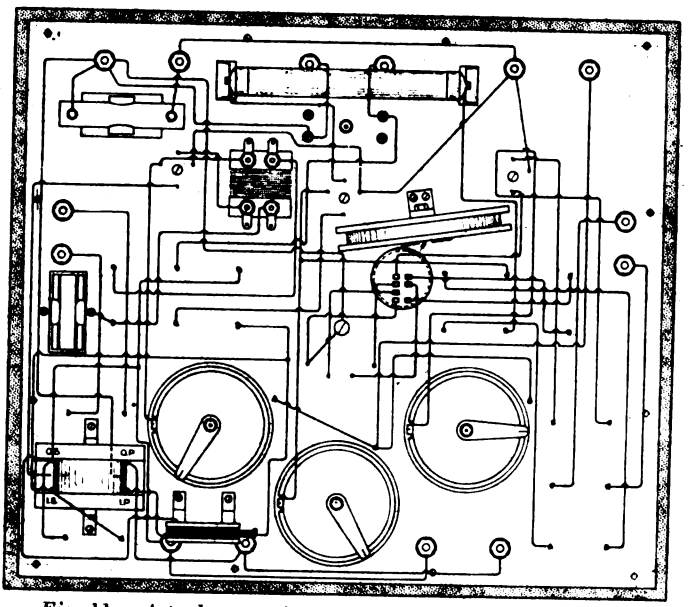


*Fig.* 11.—*Actual connections on underside of the panel. For photograph, see Fig.* 13.

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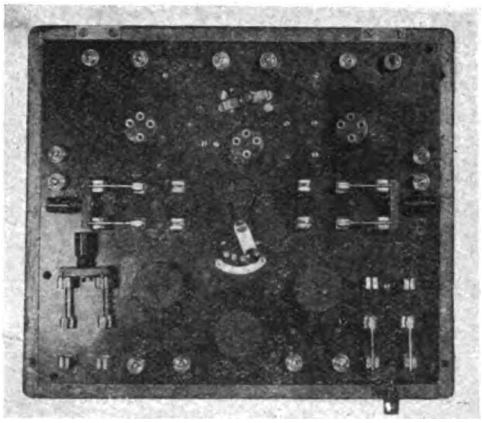

*Fig. 12.—Photograph of the top of the amplifier. The change-over switches are set for the use of all three valves, with the L.R. telephones. The H.F. transformer switch is set for waves over 3,000 metres.*

cleaned bolt by rubbing it with flux and solder until an even coating of solder adhered to the end, and then to press the end of the bolt on to the screw-head, on which a touch of flux had been placed. The surplus solder will run on to the screw-head and if the temperature of the bolt is correct will adhere after ten or fifteen second's contact. The end of the wire should previously be bent into a closed loop, slightly smaller than the head of the screw and held against the bit so as to make a film of solder cover the loop. The loop and the screw should then be brought into contact and the bit held firmly on to them until the solder on both melts. Withdraw the bolt and hold the wire steadily in place for a moment until the solder sets. This makes a neat and efficient joint with a minimum of solder.

When bending the wires to shape, care should be taken to keep them well away from one another—an interval of about an inch was aimed at in the instrument described. This makes the wiring look clumsy, it is true, but it avoids many troubles which otherwise occur in amplifiers.

Wherever it was necessary to attach a component to the ebonite panel from beneath, a hole was drilled to take a 6 B.A. cheesehead screw. A slightly larger drill, of the exact size of the cheesehead, was then taken, and the hold drilled a second time from the top of the panel for the exact depth of the head. The screw then dropped in flush, and the apparatus beneath was easily attached by nuts. The two transformers (high and low frequency) are both attached this way, as well as the clips for the condenser and grid-leak combination. The small shunt condensers were also held up in this fashion.

It will thus be seen that the whole work of constructing this amplifier can be carried out without the tapping of holes or the threading of screws, with practically no tools but a twist drill, with a set of drills from $\frac{1}{8}$ to $\frac{1}{4}$ in steps of 1/32nd (all these are not actually required), a pair of wire-cutting pliers and a soldering bit. Actually, the particular apparatus described was assembled in comfort by the dining-room fire, the gas-pipe for the soldering bolt being attached to the tap designed for a gas fire.

It will be noticed that six terminals are fitted to the back of the instrument. The pair on the left are for the L.T. battery, those in the centre for reaction (shorted by the switch below them), and those on the right for the H.T. battery. On the left of the instrument are two terminals placed in such a position that they may be connected by two short wires to the valve terminals of the Mark III tuner. On the right side are another pair of terminals which can be used either for high resistance telephones or to connect to a further L.F. amplifier if necessary. Two pairs of terminals on the front of the panel are for two pairs of telephones (low resistance) in parallel, or for one pair of telephones and a loud speaker.

In use, the apparatus is set on a small portable table erected by the window, the Mark III tuner and the amplifier standing side by side (see Fig. 14). The lids are removed from both boxes by sliding them off the hinges The 6-volt, 30-amp. accumulator stands on the floor below and is connected by electric light flex to the proper terminals, while the H.T. battery (two 30-volt. units with wander plugs) stands on the side of the table by the amplifier. A complete set of duolateral coils (100, 150, 200, 300, 400, 500, 750 and 1,000 turns) is kept on the table ready for a quick exchange together with *The Wireless World* Regular Transmissions Sheet and the Wireless Board List of Radiotelegraphic Waves. This last publication is issued by the Government at the price of 1s. and is of foolscap size. The left-hand pages are devoted to spark stations and the right-hand to continuous wave stations. The stations on both sides are listed according to their waves in strict numerical order, and the book is very useful for recording the coil number and condenser reading of any station that is heard. If such notes are regularly made, the adjustment of a station not previously heard, but the wavelength of which is known, can be

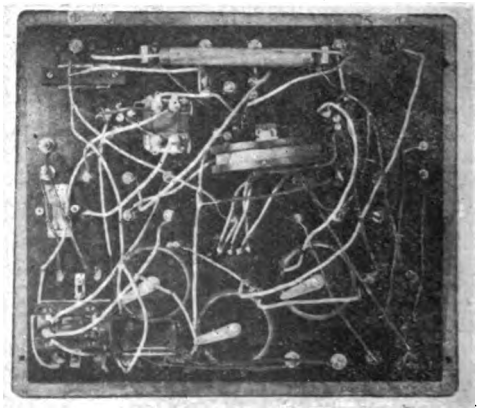

*Fig. 13.—Photograph of the underside of the amplifier. At the top is the tubular condenser and grid leak combination. The high-frequency transformer with its connections to the switch is immediately below this, and the low-frequency transformer on its left. The telephone transformer is in the bottom left-hand corner. Notice how the filament resistances are staggered to economise space.*

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predicted from the readings of other stations whose waves are round about the same figure. The writer has found the book of great value in this connection.

Using this installation with all three valves working, the writer finds no difficulty in reading New York Central, Tuckerton, Annapolis, New Brunswick, Marion and Glace Bay, on any evening when the atmospherics are not too bad. Often when conditions are rather bad and transmissions to the continental stations from America are carried out by duplicating each word, the whole message can be taken with ease on the first words. It has been noticed that the British stations seem to receive far better than those on the continent.

On evenings when conditions are particularly good, New York Central can be read several feet off the telephones, or with one valve and the telephones on, and on the evening of the 13th January (to give but one example) Darien NBA was clearly readable with the 'phones on the table. A week later NZR (Cayey, Porto Rico), was heard on two valves. All European high-power stations are much too strong to be comfortable on three valves, and Nauen can always be read in the next room, as can Poldhu, Carnarvon, Stavanger, Eilvese, Paris and others. The H.F. transformer is very selective, and even with full amplification on all valves there is no suspicion of howling. The low aerial makes for considerable freedom from atmospherics—a point not always realised by amateurs. The Dutch concert, while audible on two valves, requires all three to give really comfortable strength. The station, it may be said, is situated in the Hampstead Garden Suburb.

Although lately, as indicated above, a set of duolateral coils has been purchased, bringing the total cost rather over the figure originally intended, excellent results had previously been obtained with a home-wound multilayer coil for wavelengths in the neighbourhood of 9,000 to 14,000 metres (see *The Wireless World*, October 2nd, October 16th, October 30th, and December 11th, 1920). For wavelengths of 600 metres and below, the windings of the tuner itself are used without external inductance. If reaction is required, a small coil is brought up against the outside of the tuner case and acts through the wood.

As to the valves, the writer has used several patterns, including, with adapters, the V24 and QX types—the latter for detecting. At the moment he is using a M-O " R " type for H.F., a M-O " B R" for detecting and a French " R " for the L.F. valve. Some of his best results have been obtained with this combination (including Darien reception).

The actual cost of this amplifier and tuner set can easily be calculated by consulting the catalogues of the various dealers. More experienced readers will probably see several possible improvements, and practically all amateurs have at least a few of the components by them. If any reader should find himself in difficulties with the constructional work, other members of the local wireless society will be able to help him, or the writer will be pleased to answer any

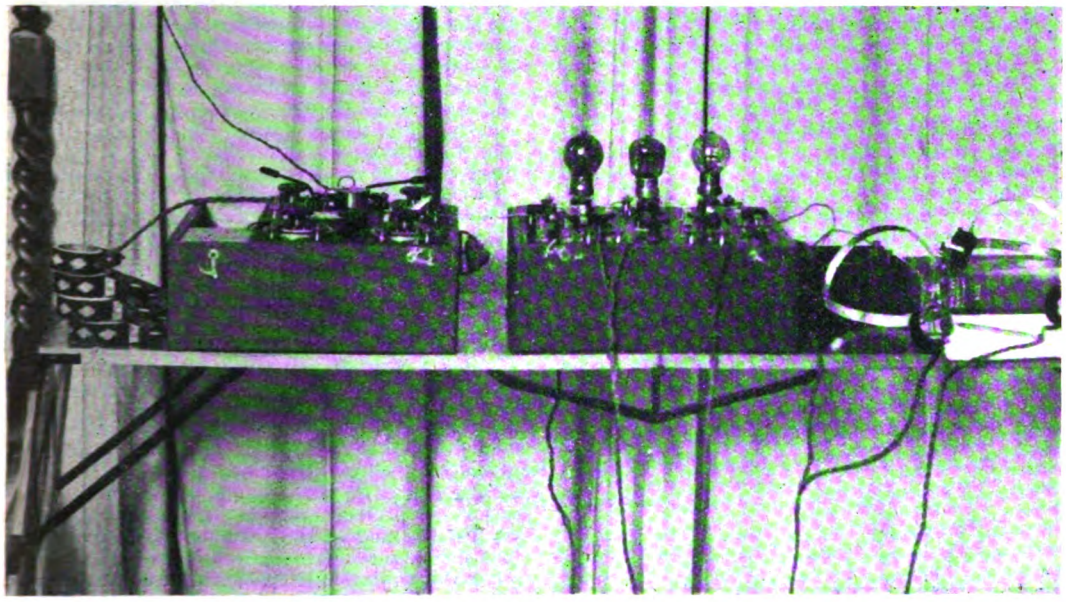

*Fig.* 14.—*The complete receiving station in use. Of the two cases, the left is the Mark III* Tuner. Extra inductances can be added to open and closed circuits, by means of the duolateral coils shown. Handles for varying the reaction and coupling with these coils can be seen at the back of the instrument. The amplifier is on the right, with two pairs of L.R. telephones and the H.T. battery. The L.T. accumulator stands on the floor and is connected by a flexible lead. American stations have been read on one valve and the West Indies on two, with this set.*

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enquiries addressed through the Editor of this magazine.

The following is a complete list of the various components required for the amplifier. From this the reader, knowing what he already has, can readily calculate the cost, with the aid of the advertisement pages of this magazine.

One empty Mark III case.
One sheet of ebonite.
One dozen Mark III terminals.
Three rotary filament rheostats.
Three valve sockets.
One H.F. transformer and switch.
One L.F. transformer.
One telephone transformer.
Three ·001 microfarad condensers (fixed).
Four battery switches.
One combined condenser and leak (·0003 and two megohms).
One pair of clips for same.
One short circuiting switch for reaction terminals.
About four dozen 4 B.A. screws, ¾ in. long, with about twice the number of nuts to correspond.
Two yards green Sistoflex tubing (6d. a yard or less).
Two yards yellow ditto.
Four yards red ditto.
One yard black or blue.
Solder and flux.
One or two pairs 120 ohm telephones.
Two 30-volt units high-tension battery.
6-volt 30-amp. (continuous rating) accumulator.
Three valves (if V24 and QX valves are used, adapters will be needed).
About ¼ lb. No. 18 bare tinned copper.
One ounce No. 22 bare tinned copper.

Many variations are possible in the design given. The writer has named the actual components used by him, but there is no reason why others should not be substituted. As mentioned previously, it would be quite possible (and indeed simpler) to mount a fourth valve socket in the place of the H.F. transformer switch, and to use this for the removable transformers described by Mr. Campbell Swinton and purchasable from several dealers. Again, other types of L.F. transformer are quite suitable. Neater switches are obtainable, but the battery type of switch is very certain in its action, and the parts are well separated.

If V24 and QX valves are used, and it is not desired to try others, the four-pin type of socket is not needed, and clips for the former valves can be substituted in the design. This saves the cost of the adapters and in addition has the advantage that the valves can be left in place when the lid is put on. With the four-pin sockets and valves, the latter must be removed when "packing up." On the other hand, if the four-pin sockets are used, any type of valve desired can be tried, with the aid of adapters.

A point about this receiving set which will appeal to many is that when packed up it consists of nothing more than two neat cases, two small boxes (the h.t. units), a box containing the set of coils on plugs, and a small accumulator. The connecting wires (including flexible leads for earth and aerial terminals), together with the telephones, go into the compartment of the Mark III Tuner, and are therefore not likely to be mislaid. The set can be fitted up in about five minutes on a small table and is not unsightly in appearance, and instead of working upstairs in a cold room as many amateurs are compelled to do, the possessor can sit by his fireside in comfort.

# Resistance Capacity Amplification

By B. L. STEPHENSON.

(*Concluded from page* 19.)

If the grid condenser and leak of the rectifying valve are of correct proportions, the set should go quite sharply from the oscillating state to a loud and constant howl, when the reactance coupling is tightened. Sometimes, if these proportions are not correct, the howl will come on faintly at first and then louder as the reactance is tightened. Also, in some cases, the howl occurs as a hammering sound, with quite a space between each noise. Both these lose a great deal of efficiency, particularly for C.W. reception, for then it is impossible to work the set just short of the howl point.

Resistance-Capacity amplifiers are badly affected by atmospheric disturbances, owing largely to the intervalve condensers getting charged up above normal, and in this case, if the set is only just clear of the howling point, a strong atmospheric or even a loud signal will start it off howling. The only way to avoid this is to work rather further away from the howling point when "X's" are bad. This, however, I should think, is more or less the same with any amplifier.

Static reactance is frequently used with Resistance-Capacity amplifiers, and although it is far more stable than magnetic reaction, it does not allow for nearly the same amount of amplification. By this method all the boosting effect of coupling the anode and aerial circuits together is lost.

Another question is whether to use H.R. or L.R. 'phones, when amplification is adopted. A step-down telephone-transformer and L.R. 'phones certainly avoid most of the parasitic noises caused by the H.T. battery and variation of resistances: and also do away with one of the greatest of all troubles—which is the capacity effects caused by movements of the body. This is most noticeable when receiving telephony. I have known telephony, so to speak, totally disappear when 'phones have been handed from one person to another. This has been caused by the change of wavelength due to alteration of capacity. A certain loss of sensitiveness is, however, unavoidable when using L.R. 'phones, and personally I always use H.R. 'phones, being careful to connect them up in the correct way with regard to the H.T. battery. This is, however, rather a strain on their insulation.

A good point about Resistance-Capacity amplifiers is that they rather tend to limit the strength of strong signals, and greatly intensify weak signals, and make otherwise inaudible signals of good readable strength. The amplifier can be made relatively stable by employing anode resistances

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of between 30 and 50 thousand ohms. In this case, however, it will be readily seen that more valves will have to be used, than when 80 or 100 thousand ohm resistances are adopted, in order to obtain the same signal strength.

A somewhat curious feature of these amplifiers is their extreme susceptibility to the reception of harmonics, particularly, of course, from C.W. stations. In many cases high-powered stations can be read on their 2nd, 3rd and 4th harmonics, and sometimes even higher than this. It will be readily seen that this becomes extremely troublesome, particularly with such stations as that at Leafield, near Oxford. This station, when sending press on a 9,000 metre wave, has more than once been clearly readable on 600 metres, and apparently about every multiple of 600 metres, up to the true wavelength, and certainly on a double harmonic above that. This was when using only a two-valve Resistance-Capacity amplifier.

I will now come to a few of the troubles which are likely to be met with when making anode-resistances and grid-leaks.

It will be observed that there is a continual and relatively large current flowing through the anode-resistances. This is probably the chief cause of trouble in their operation, for under these conditions it becomes very difficult to keep their resistance value constant. A pencil line between two terminals on ebonite, seems to work well for a short time, but then, amid much crackling in the telephones, it varies until its resistance may reach a value several times as high as it was originally. This is probably caused by the coherer action of the particles of graphite, which move along with the current, and thus greatly vary the resistance. In my own case I avoided this to some extent, by using slate-pencil instead of ebonite. This allowed the graphite to obtain a firmer bedding, and thus stopped the coherer action. Here, however, there is another difficulty, for the slate-pencil cannot very well be sealed up by any other means than varnish. This, of course, changes the resistance and great trouble is found in obtaining the desired value. In the case of the ebonite resistances another piece of ebonite was used as a covering, thus avoiding touching the actual pencil line with varnish.

It is essential that the resistance should, in some way, be protected from damp and the varying humidities of the atmosphere, and to do this, at the same time as keeping the resistance value constant, will probably be found extremely awkward. In any case these resistances can be purchased for quite a small sum, and I have found them satisfactory in every respect, although they have now been in use for some months.

In the case of the grid-leaks we have a much simpler proposition, for the current passing through the resistance is negligible. An ordinary pencil line on ebonite seems to act quite well, and will keep constant provided it is protected from damp. This can easily be done by a covering of ebonite, and a coat of shellac varnish round the edges.

A thing which should most certainly be paid great attention to in Resistance-Capacity amplifiers is the relative position of the various parts of the set. These amplifiers are extremely prone to self-oscillation, and any stray capacities or magnetic linkage between the various parts is liable to make the circuit oscillate even more readily than usual. This trouble becomes greater and greater as the number of valves is increased, and when even a moderate number such as four are used it becomes rather difficult to stop the set oscillating, for spark and telephony reception.

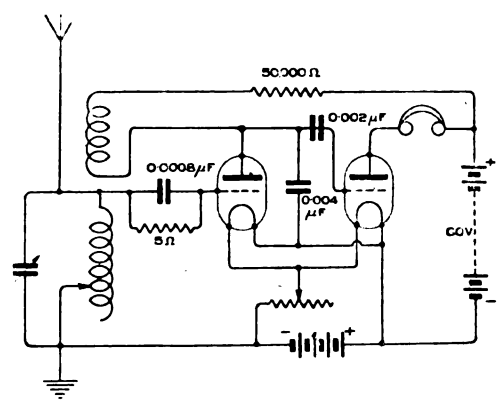
Strong self-oscillation may also be caused by an unsuitable selection of valves, and in my own opinion it is advisable to fit out an amplifier throughout with ordinary "R" type valves, which have fairly constant properties, and seem to be extremely sensitive.

*The following description was then given of a two-valve detector amplifier exhibited.*

I have used a rather special circuit, shown herewith, which departs in certain details from the usual form of Resistance-Capacity amplifier.

Here the anode-resistance is of 50,000 ohms, the first grid-condenser of 0·0006 mfd., the second grid-condenser of 0·002 mfd., and the extra condenser, which is placed between the grid of the second valve and earth, is of 0·004 mfd. capacity.

This panel has given good results, particularly in the reception of signals from distant stations. Upon several occasions American stations have




been read when using only a short indoor aerial. The result of the Carpentier-Dempsey fight was received from New Brunswick (WII), and the whole of President Harding's message, sent from the New York Central Station (WQK) was read.

The high-powered European stations at Carnarvon, Clifden, Leafield, Eiffel Tower, Lyons, Nauen, Hanover, Rome, etc., come in so loudly that they can be heard all over a large room. The American stations at New York, New Brunswick, Annapolis, Marion and Tuckerton, can also, under good conditions, be heard at quite a distance from the 'phones. All the above are when using an outdoor aerial, of course.

Telephony from Koenigswusterhausen (near Berlin), and from the Eiffel Tower has been heard well, as also have several of the 900 metre air-stations such as Croydon.

The fact that telephony from the Mersey Bar Light-vessel and the Liverpool dock offices has been clearly received, on a wavelength of about 450 metres, largely dispels any idea of the inefficiency of this circuit on low wavelengths.

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# Notes on the Design of Radio Frequency Intervalve Amplifier Transformers using Iron Cores*

By A. S. BLATTERMAN, B.Sc., E.E.

## General

Numerous engineers have built and used radio frequency amplifiers in which the coupling between stages was provided by iron core transformers. M. Latour seems to have been the pioneer in this work and during the World War his lead was followed more or less in an imitative, cut-and-dry manner by others. No analytical treatment of the subject, however, nor formulæ or data for design have thus far appeared. The writer some time ago worked out a rational method of designing these transformers which has proved useful, and it is the purpose of the present communication to describe this method as well as to discuss briefly some of the more important though somewhat obscure factors which enter into the design of this type of apparatus. All of the work referred to has been conducted at the U.S. Signal Corps Laboratories at Camp Alfred Vail, N.J., U.S.A.

The problem of designing intervalve amplifier transformers for radio frequencies is essentially one of coupled tuned circuits. The primary circuit comprises one winding of the transformer constituting principally an inductance, and a composite capacity involving the several capacities between the elements

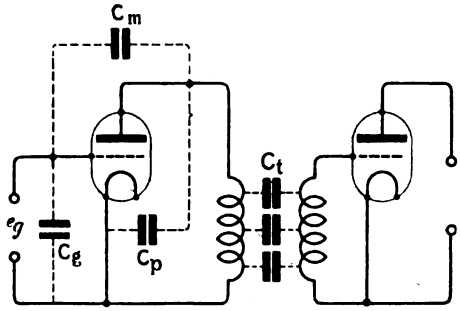


*Fig.* 1.

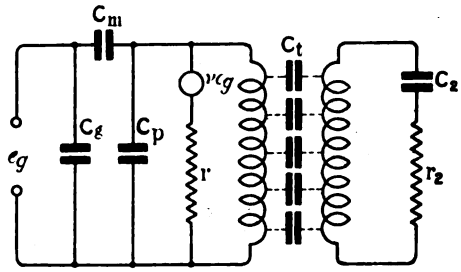


*Fig.* 2.

of the input tube. The secondary circuit comprises the inductance of the other transformer winding and the grid circuit impedance (usually capacity and resistance of the output tube). The actual circuits are those of Fig. 1 and their analytical equivalent is shown on Fig. 2.

It is evident from Fig. 2 that the primary and secondary circuits can be reduced to the simple form of Fig. 3, in which as will be shown later $C_2$ and $r_2$ comprise the effective input impedance of the grid circuit of the second or output tube depending upon the load in the plate circuit of that tube, as has been shown by Dr. J. M. Miller.

The analytical treatment is considerably complicated by the existence of the capacity $C_t$ between the transformer windings, which moreover is not generally necessary for the successful functioning of the amplifier. We shall, therefore, limit the present discussion to the case of pure inductive coupling and hence consider only a transformer in which the capacity between windings is negligibly small. Such a transformer comprises thin pancake wound coils rather than overlaid solenoidal primary and secondary.

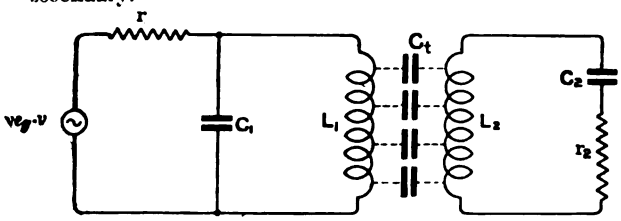


*Fig.* 3.

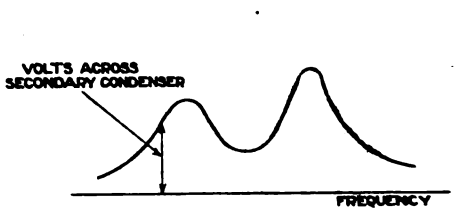


*Fig.* 4.

The pair of coupled circuits as here presented have in general two frequencies at which maximum voltage is obtained across the secondary terminals. When the frequency impressed upon the primary is varied, the resonance curve presents two peaks as indicated roughly in Fig. 4. The separation between the peaks depends upon several factors of which very important ones are the coefficient of

* Received August 29th, 1921.

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coupling and the internal resistance of the input tube. The latter quantity is fairly well fixed for a given tube while the former is under control according to the design of the transformer. If the coefficient of coupling is very small the peaks become closely identified with the separate frequencies of the primary and secondary circuits. As the coupling is increased the peaks become more widely separated. By properly proportioning the time constants of the two circuits as well as the coefficient of coupling the two peaks may be made to coalesce, or one may be relegated to zero frequency. In either case the system then behaves as one responsive to but a single frequency.

In practice it may be desirable to produce either the single or double hump characteristic depending upon whether or not the amplifier is required to be effective over a narrow or a relatively wide range of wavelengths. The predetermination of the coupling coefficient is therefore of great importance. This obviously involves the calculation of leakage flux in the transformer. The determination of the inductances of the transformer windings is also necessary in order to discover the effective region of operation with respect to wavelength. This likewise requires that an estimate be made of the various magnetic fluxes. It is found that practically any desired characteristic can be obtained by suitably adjusting the turns, the spacing between primary and secondary, and the air gap in the core of the transformer.

## Determination of Leakage Flux

The type of transformer to be considered is shown in Fig. 5; other cases where the windings are split into several sections will be discussed later. The leakage flux is indicated in dotted lines. The width of the pancake windings is negligibly small compared with the separation of primary and secondary elements. In practice the size of the central core leg is somewhat larger than the two side legs, although on account of the corner drilling for clamping screws and consequent stricture of iron section at these points the difference in cross-section between central and side members is not great. The section is square for convenience.

In order to simplify the analytical problem it will be assumed (1) that the size of the side and central core members are equal and (2) that the section is circular instead of square. It will be seen from the formulæ developed that such assumptions give results which differ only slightly from those to be expected from a rigorous treatment using the actual transformer core.

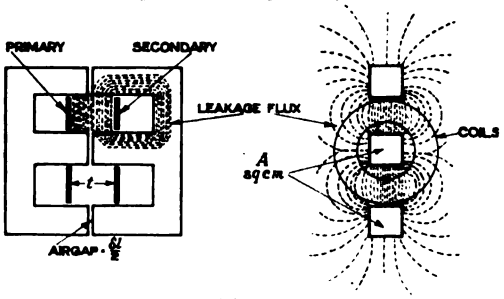


*Fig. 5.*

Let $N_1$ = number of primary turns.
$N_2$ = number of secondary turns
$l$ = mean length of iron core circuit (cm)
$\delta l$ = total length of air gap (cm)
$t$ = separation of prim. and sec. (cm)
$A$ = cross-section of iron in core (sq. cm)
$\mu$ = permeability of iron core
$R$ = radius of assumed round core (cm)
$b$ = width of window in core (cm)

The leakage flux $\phi$ passes through the air space between primary and secondary windings from the central core leg to the two side legs and returns (principally) through the iron end pieces. The return path being through iron can thus be neglected as far as its reluctance is concerned and the problem centres only upon the calculation of the reluctance of the air paths between central and side core legs. Such paths are shown in Fig. 6.

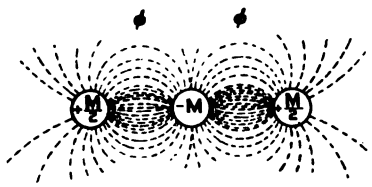


*Fig. 6.*

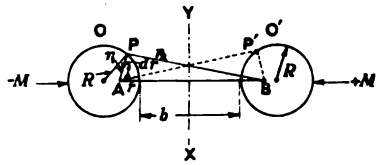


*Fig. 7.*

In order to get information on the method of calculating this problem let us first consider the simpler problem where there are only two cylinders as in Fig. 7 instead of three. In this case the magnetic charges on the two cylinders are equal but of opposite sign +M and −M respectively. Let the two cylinders be considered as of infinite length and more specifically indicate by $M$ the magnetic charge per unit length. Designate by $\phi'$ the number of lines of flux passing between the cylinders per cm of their length. Then

$$\phi' = 4\pi M$$

All points in the surface of each cylinder are at the same magnetic potential. The plane XY midway between the cylinders is at zero potential and hence a reference for all potentials in the system.

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A and B are the inverse points for the system, and as such can be considered as the locus of the entire charges $-M$ and $+M$ respectively, which reside upon the cylinders O and O′. The potential at P, a point on core leg O due to $-M$ at A is

$$\int_0^{r_1} \text{Intensity of field at } r \times dr = \int_0^{r_1} -\frac{4\pi M}{2\pi r}\,dr = -2M\int_0^{r_1}\frac{dr}{r}$$

The potential at this point due to $+M$ at B is similarly $2M\int_0^{r_2}\frac{dr}{r}$

The resultant potential at P due to both A and B co-acting is therefore

$$V = \left(-\int_0^{r_1}\frac{dr}{r} + \int_0^{r_2}\frac{dr}{r}\right)$$

$$= 2M\log\frac{r_2}{r_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This is the potential at all points on the cylinder O.

In a similar way the potential of P′, a point on O′ and hence the potential of all points of O′ is

$$V' = -2M\log\frac{r_2}{r_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Therefore the magnetic potential between the two core legs is

$$V - V' = 4M\log\frac{r_2}{r_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Since the reluctance is

$$\mathfrak{R} = \frac{\text{magnetic potential}}{\text{flux}}, \quad \text{and flux} = 4\pi M \text{ per cm length of core}$$

we get

$$\mathfrak{R} = \frac{4M\log\frac{r_2}{r_1}}{4\pi M}$$

$$= \frac{1}{\pi}\log\frac{r_2}{r_1} \text{ per cm} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

By the theory of inverse points the ratio $r_2/r_1$ is constant, and it may be otherwise expressed in terms of the constant dimensions of the system. Thus it is easily shown that—

$$\frac{r_2}{r_1} = \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

and the reluctance between two infinitely long parallel magnetic cylinders per cm of their length becomes

$$\mathfrak{R} = \frac{1}{\pi}\log\frac{2R}{b + 2R - \sqrt{(b^2 + 4bR)}} \quad \ldots\ldots\ldots\ldots (6)$$

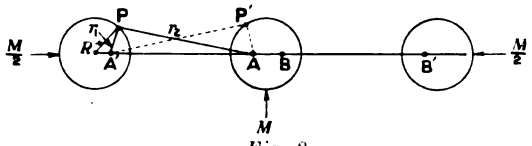


*Fig. 8.*

Turning now to the problem of the three-legged core, Fig. 6, we have the inverse points A and A′ for the central and left hand cores and B and B′ for the central and right hand cores. (See Fig. 8.)

The magnetic potential at P due to $\frac{M}{2}$ at A′ is $V_1 = -M\log r_1$

Potential at P due to $-M$ at A is $V_2 = 2M\log r_2$

Potential at P due to charges at A′ and A co-acting is

$$V = V_1 + V_2 = M\log\frac{r_2^2}{r_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Potential at P′ due to $+\frac{M}{2}$ at A′ is $V_1' = -M\log r_2$

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Potential at P′ due to $-M$ at A is $V_2' = 2M \log r_1$

Potential at P′ due to charges at A′ and A co-acting is

$$V' = V_1' + V_2' = -M \log \frac{r_2}{r_1^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Therefore the potential between the middle and the side legs is

$$\begin{aligned} \overline{V} &= V - V' \\ &= M \log \frac{r_2^3}{r_1^3} \\ &= 3M \log \frac{r_2}{r_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9) \end{aligned}$$

Therefore the reluctance per cm length between one side leg of the core and the central number is

$$\mathfrak{R} = \frac{\overline{V}}{\text{flux}} = \frac{3M \log \frac{r_2}{r_1}}{2\pi M} = \frac{3}{2\pi} \log \frac{r_2}{r_1}$$

The total reluctance between the central core and the two side legs is evidently one half of this or

$$\begin{aligned} \mathfrak{R} &= \frac{3}{4\pi} \log \frac{r_2}{r_1} \text{ per cm} \\ &= \frac{3}{4\pi} \log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}} \quad \ldots\ldots\ldots\ldots (10) \end{aligned}$$

It is interesting to note by comparing (6) and (10) that the reluctance of the three-legged system is only three-fourths that of the two-legged one.

If, instead of 1 cm of core length we consider a length $t$ cm as, for instance, the distance between primary and secondary coils the formula for reluctance becomes

$$\mathfrak{R} = \frac{3}{4\pi t} \log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}} \quad \ldots\ldots\ldots\ldots (11)$$

An idea can now be had from this formula of the extent of the error made in assuming that the central and side core legs are of equal size. It is seen that the function involving their dimensions is a logarithm, and hence the reluctance is but slightly affected by small changes in the radial measurement.

*(To be continued.)*

# "The Wireless World and Radio Review"

In connection with the amalgamation of *The Radio Review* and *The Wireless World*, and the weekly publication of the combined journal, the following additional communications have been received:—

**From Professor G. W. O. Howe, D.Sc., M.I.E.E.**

I am very pleased to fall in with the Editor's suggestion that I should write a short note for publication in connection with the issue of the combined *Wireless World* and *Radio Review*.

As Editor of the *Radio Review* from its inception until January last I cannot but regret that it should now cease to enjoy a separate existence. At the same time I believe that the amalgamation of *The Wireless World* and *The Radio Review* will make it possible to produce a magazine of more general interest to the readers of both. *The Wireless World* has become the recognised organ of the great amateur wireless organisation; a great number of the members of the various Wireless Societies are, however, keenly interested in the scientific and commercial development of the subject and are able to appreciate the writings and work of those who are engaged in the wireless industry or of those who are endeavouring to develop the subject from the mathematical or experimental side. On the other hand much valuable work is being done by many amateurs and nothing but good can come of a literary *rapprochement* between those who have previously confined their attention to one or the other journal.

It is with considerable misgivings that I learn that the abstracts of Wireless Literature, which formed such an important part of *The Radio Review*, are not to be made such an important feature of the new magazine. There is no doubt that many contributors regarded this as the most important feature of *The Radio Review* and will miss it very much. I have no doubt, however, that in some form or other, the readers of the new journal will be kept informed as soon as possible of any important publications bearing on radio telegraphy which may appear from time to time in various foreign periodicals.

One of the most welcome features of the new journal is its weekly publication; this will enable the announcements of meetings and the reports of papers and discussions to appear without the delay which is unavoidable with a monthly magazine.

I should like to conclude by expressing the hope that the new *Wireless World and Radio Review* may have the full support of every one connected in any way with British Radio-Telegraphy, whether amateur or professional, commercial or academic, so that it may become representative of the part taken by this country in the development of Radio-Telegraphy.

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**From Mr. E. H. Shaughnessy, M.I.E.E., of the Engineer-in-Chief's Office, General Post Office.**

The amazing growth of interest in the radio art and the manner in which the successive issues of *The Marconigraph* (1911) and *The Wireless World* (1913) have advanced in step with the progress of the art augurs well for the future of the enterprising venture of the issue of *The Wireless World* as a weekly magazine. I think we can safely leave it to the Editors of *The Wireless World* to see that those who were particularly interested in the class of literature dealt with by *The Radio Review*, the decease of which is a matter of regret, will find sufficient space devoted to their wants in the new issues.

It is certain that *The Wireless World* will now more than ever form an essential part of the engineering literature of the day, and I wish the new venture every success and continued support from an extended number of subscribers.

# Notes

**Prof. H. Fassbender** has relinquished the editorship of the *Jahrbuch Zeitschrift für drahtlose Telegraphie* on his appointment as Professor of Electrical Engineering at the University of La Plata. His editorial duties have been taken over by Dr. Eugen Nesper. The title of the publication has now been changed to *Jahrbuch der drahtlosen Telegraphie und Telephonie: Zeitschrift für Hochfrequenztechnik.*

**Wireless Patent Actions.**

In an action brought by Marconi's Wireless Telegraph Company, Ltd., against F. O. Read & Co., Ltd., an order was made in the High Court of Justice, Chancery Division, by Mr. Justice Russell on February 17th, 1922, restraining Messrs. F. O. Read & Co., Ltd., from infringing letters patent Nos. 13636 of 1913, 28413 of 1913, 252 of 1914, and 126658. Messrs. F. O. Read & Co., Ltd., were further ordered to destroy all infringing apparatus made or used by them, and to pay the Marconi Company damages and costs.

In an action brought by Marconi's Wireless Telegraph Company, Ltd., against A. C. Cossor, Ltd., an order was made on March 1st, 1922, restraining Messrs. A. C. Cossor, Ltd., from infringing letters patent Nos. 284133 of 1913, and 126658, except so far as they manufacture for H.M. Government. Messrs. A. C. Cossor, Ltd., were also ordered to destroy infringing apparatus manufactured or used by them (except that constructed to the order of H.M. Government) and to pay damages and costs. Abridgements of Patents 13636 of 1913, and 28413 of 1913, appeared on page 685 of the issue of *The Wireless World* for February 4th, 1922.

Patent No. 252 of 1914 relates to valve circuits in which reaction is employed for generation, heterodyning, etc.

Patent 126658 relates to the type of valve which is usually referred to in wireless circles as the French type.

**Dutch Concerts.**

It has been brought to our notice that a good number of amateurs conduct experimental transmissions during the period of the Dutch Concerts on Sunday afternoon, and as numerous complaints have been received on the subject, particularly regarding transmissions originating in Yorkshire, we think that readers may care to have the matter brought to their notice.

**Scouts' Concert Party and Display.**

The 16th Bournemouth Troop (St. Paul's) gave a successful concert and display in St. Paul's Gymnasium recently before a large audience that filled the hall.

A special feature of the evening was a demonstration in wireless telegraphy and telephony received on the aerial attached to the wireless section of the St. Paul's Scouts.

The telephony transmissions of music and speech were sent by Mr. H. C. Binden from his station, and the receiving apparatus enabling the results to be heard over the large hall were kindly supplied and operated by Mr. T. H. Dyke, of Winton, for this occasion.

**Rhondda Valley Amateurs.**

Mr. D. V. Briggs, of 5, Llwynmadoc Street, Graigwen Road, Pontypridd, Glam., states he is in touch with several amateurs in his district, and it is desired to start a wireless society for the Rhondda Valley. All those in this district who are interested are invited to communicate with Mr. Briggs.

**Correspondence.**

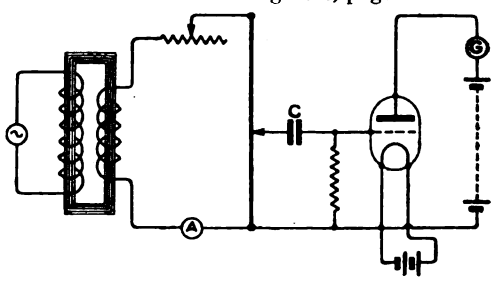
In Mr. B. S. T. Wallace's letter, published under "Correspondence" in the issue of *The Wireless World* for March 4th, "200 miles" should read "2,000 miles."

## SHARE MARKET REPORT.

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 2 | 3 |
| ,, Preference .. .. | 1 | 18 | 6 |
| ,, Inter. Marine .. .. | 1 | 8 | 9 |
| ,, Canadian .. .. | | 8 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | | 14 | 0 |
| Preference .. .. .. .. | | 13 | 0 |

## A CORRECTION.

In the article entitled "A Sensitive Direct Reading Voltmeter and Ammeter for High Frequencies," by E. B. Moullin, M.A., which appeared in the last issue, the figure given below should be substituted for Figure 1, page 2.

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# Calendar of Current Events

**Tuesday, April 11th.**

Transmission of Telephony at 7 *to* 7.25 *p.m.* on 700 metres followed by C.W. Calibration Signals on 1,000 metres, by 2MT at Writtle, near Chelmsford.

**Wednesday, April 12th.**

COWES AND DISTRICT RADIO SOCIETY.

"Semi-Aperiodic Amplifiers and the Reaction Principle."

RADIO SCIENTIFIC SOCIETY, MANCHESTER.

At 61, High Street, Manchester. Open evening.

**Thursday, April 13th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

At Colquitt Street, Liverpool, "Accumulators, How Made, Used and Abused," by Mr. S. K. Wilkie.

ILFORD AND DISTRICT RADIO SOCIETY.

Social evening.

**Friday, April 14th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—At University of Leeds, College Road, Leeds, "Samuel Morse," by Mr. W. R. Plowers. "High Frequency Intervalve Transformers," by Mr. G. F. Kendall, B.Sc.

**Wednesday, April 19th.**

NORTH MIDDLESEX WIRELESS CLUB.

8 *p.m.*—At Shaftesbury Hall, Bowes Park, "Electro-Chemistry," by Mr. R. Maxwell Savage, B.A.

COWES AND DISTRICT RADIO SOCIETY.

"Independent and Self Heterodyne Methods."

**Friday, April 21st.**

WIRELESS SOCIETY OF HIGHGATE.

7 *p.m.*—Lecture and demonstration by Lieut. Walker.

BRADFORD WIRELESS SOCIETY.

7.45 *p.m.*—At 5, Randallwell Street, Bradford. Meeting.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—After reading Mr. Ellison's letter in *The Wireless World* of February 18th, I believe that I can give you some information concerning amateur work in America that will be of interest to your readers.

It seems to be the impression of Mr. Ellison that spark transmitters are used chiefly in America. Eighteen months ago CW transmitters were almost unknown to amateurs. Up to that time I had never heard an amateur CW. Since then we have been changing over to CW very rapidly, and the CW is far in the lead of the spark now, but the sparks are not entirely out of use. The prospects are that the sparks will soon be entirely out of use.

As for ability to tune a set to 180 metres, we consider that the CW is easier to make operate on short waves than the spark. Without apparatus CW allows a shorter wave to be used than can be easily used with a spark set. Any of our receiving or transmitting tubes will oscillate as low as 100 metres, and the General Electric Co. have had tubes in their laboratories that oscillate as low as 6 metres.

Regarding the receiving of short waves, the difficulty of a high frequency amplifier to operate on so short a wave has prevented any use whatsoever of radio frequency amplification. All amateur stations here are equipped with low frequence amplifiers, if any. The usual equipment is a detector tube and two low frequence amplifiers. There are now iron core radio frequence transformers advertised, which are expected to make great changes in our receiving equipment, but as yet the manufacturers have not started deliveries of them, so we have only their word for what they will do.

As Mr. Ellison stated, there are very few amateur telephone stations. There are many for short range work, with a range of a few miles, but none to compare with the telegraph stations. The great ambition of an American amateur is to cover the greatest distance possible, so he prefers to use any telephone transmitter as a CW telegraph transmitter, with a much greater range.

We have dozens of radio telephone stations operating on about 360 metres, sending concerts, speeches, market reports, and other broadcasts. These stations have commercial licences, and most of them have an output of ½ kW. They are operated every evening by commercial companies who manufacture receiving apparatus. The prospects are that with a few months there will be one hundred men with receiving sets intended solely to get music to every amateur we have now. All of these stations are new, except the one at Pittsburgh, Pennsylvania. This station, owned by the Westinghouse Electric and Manufacturing Co., has been operating since January 1st, 1921. When this station had been operating one year there was a receiving set in every sixth home in Pittsburgh. The prospects are that within a very few months it will be that way all over America. Just now the rush for receiving apparatus is so great that all manufacturers are swamped with orders, and every manufacturer, distributor, and retail dealer is entirely out of stock of receivers and parts. We have to wait from weeks to months to get any parts for receiving sets. Within the last few days several of my friends have driven by auto to numerous cities within fifty miles in a search for vacuum tubes, but there are absolutely none to be had.

VICTOR ANDREW.

Wooster Radio Store,
Wooster, Ohio, U.S.A.
*March 6th*, 1922.

# Books Received.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1922 (London: *The Wireless Press, Ltd.* Pp. 1476. Demy 8vo. Price, 15/- net.)

MARINE WIRELESS POCKET BOOK for the Practical Operator and Student. By W. H. Marchant. (London: *Sir Isaac Pitman & Sons, Ltd.*, 1922. Pp. 180. 6½" × 4". 138 diagrams. Price 6/- net.)

LEKTRIK LIGHTING CONNECTIONS. Seventh Edition. (London: *A. P. Lundberg & Sons.* Dec. 1921. Price 1/- net.)

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# Wireless Club Reports

*NOTE.— Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## The Wireless Society of London.

The Forty-sixth Ordinary General Meeting was held on Wednesday, March 22nd, at the Institution of Electrical Engineers, at 6 p.m.

**The President,**

The balloting list is being circulated and will be collected at the end of the meeting. I am glad to see another lady is going to join us. Four Wireless Societies have also been affiliated. This concludes the business.

Capt. Donisthorpe who had proposed to give us a lecture this evening on "Harnessing Electrons," has unfortunately been prevented from attending owing to pressing business. He will, however, give his lecture at a later date. In the meantime Mr. G. G. Blake has kindly offered to take his place by giving us a paper entitled "The Modern View of Electricity and the Three-Electrode Valve with Experiments."

I call upon Mr. Blake to give his lecture.

(For Report of this paper see next issue.)

At the conclusion of the paper and discussion, the President announced that the following had been elected to membership of the Society:—Members: Henry Alexander Sherwin Gothard, Alfred Edward Joseph Symonds, Miss Florence Parbury, Albert Edward Grocott, John Francis Atherton, Herbert Lee Serjeant. Assoc. Member: Douglas Sisson Relph, and that the following Societies had been accepted for application:—The East London Radio Society, The Wallasey Wireless and Experimental Society, The South London Wireless and Scientific Club, The Southend and District Wireless Club.

The meeting adjourned at 7.15 p.m.

## The West London Wireless and Experimental Association.*

The attendances at the weekly meetings have of late greatly improved, much to the satisfaction of the officers of the Association, and new members are still joining the flock of experimenters.

At the General Meeting, on January 26th, the new rules which had been previously framed by the Committee were fully discussed, and each rule was passed by the members present. At the completion of business, Mr. R. Cole gave a very interesting paper entitled "Aerials and Circuits for Amateurs," which was very much appreciated, especially by the younger members.

Meeting held February 2nd.—Morse practice was taken by a large number of the members and afterwards the Vice-President, Mr. F. E. Studt, gave a very interesting lecture and demonstration, entitled, "The Oscillating Wavemeter and the Uses of Harmonics in Wireless." A very hearty vote of thanks was accorded the lecturer for the great trouble he had taken in preparing the demonstration.

Meeting February 9th.—Morse practice was well attended after which Mr. C. W. Hirst read a paper and demonstrated "The Making of Lattice Coils of Various Designs." This was a very useful subject, especially for the junior section.

Meeting February 16th.—The President, Mr. Geo. Oxford, announced that the committee had decided that one meeting a month would be set aside for open discussion after the Morse practice class. Mr. I. F. Bruce took the opportunity of presenting to the Association a Morse practice set, comprising an efficient buzzer connected to a special form of loud speaking telephone. Incorporated with the set was an addition of Mr. Bruce's own design and manufacture. This consisted of a silent buzzer furnished with an adjustable secondary circuit, to which a series of telephones can be connected. The fluctuations of current in the buzzer circuit are, by induction, impressed on the telephone circuit and a signal which exactly simulates a musical spark note is obtained. The intensity of the signal can be varied from very strong to an almost inaudible limit. After a description of the instrument by Mr. Bruce a very hearty vote of thanks was expressed to the donor in the usual manner. Mr. L. V. Clarke also presented four pairs of headphones for use with this instrument, and was also accorded a hearty vote of thanks by those present.

Meeting February 23rd.—Mr. F. E. Studt continued his series of theoretical papers.

Meeting March 2nd.—The Librarian announced that he had purchased a few new books, which would be available for members the next week. Mr. L. Shepherd was appointed Instrument Steward. Mr. Mullings read a very interesting paper entitled "Construction of Electric Motors and Generators."

Meeting March 16th.—The President announced that the Committee were expecting to arrange for demonstrations to be given by Messrs. H. D. Butler & Co., also the Marconi Scientific Instrument Co., shortly, and all members are asked to make a special effort to be present. Any gentlemen desiring particulars as to membership and objects of the Association should communicate with the Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex, who will have much pleasure in sending information by return.

## North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 4th Annual General Meeting of the Club was held at Shaftesbury Hall, Bowes Park, on Wednesday, March 22nd, Mr. A. G. Arthur being in the chair.

The minutes having been read and passed, the Chairman called on the Hon. Secretary to read his report for the year. Mr. Savage said that the Club

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had made good progress during the year under review, as regards its position as a Club. Meetings had been well attended, and it had been the Committee's endeavour to provide an attractive programme at each meeting.

The Hon. Treasurer's report showed a balance in hand of £7 16s. 4d. This amount, although not large, was sufficient to meet any expenses which were likely to arise in the near future. At the same time, there were a number of subscriptions due for renewal, and when these were in, the position would be better still.

The Installation Officer's report showed that the Loan Scheme was working well, and a number of valuable instruments had been added to the Club's installation, the Committee having felt that this course was the one most calculated to serve best the interests of members, rather than to keep a large reserve of cash in hand.

The Librarian reported that the library books were in great demand, particularly the most up-to-date ones.

All the foregoing reports were adopted.

A vote of thanks was moved to the retiring officers by Mr. A. J. Dixon, and seconded by Mr. Symons, who spoke in a very appreciative manner of the work done by them during the year. Mr. Savage spoke a few words thanking Mr. Symons on behalf of the Officers and Committee, and said how grateful he was for the help given by Mr. Arthur. The following were then elected as officers for the year :—

President, Mr. A. G. Arthur; Vice-Presidents, Mr. Wm. Le Queux and Mr. C. Midworth, A.M.I.E.E. Chairman, Mr. G. Evans; Hon. Secretary, Mr. E. M. Savage; Hon. Treasurer, Mr. W. A. Saville; Hon. Installation Officer, Mr. A. J. Dixon; Hon. Librarian, Mr. H. A. Beers.

Committee, Messrs. Gartland, Green, Holton, Symons. and Wordham.

### Wireless and Experimental Association.*

At a meeting held at the Central Hall, Peckham, on March 15th, Mr. Joughin, a member, gave an account of how he had made a milliamperemeter capable of measuring almost anything in volts and amperes. Major Webb was in the chair.

Mr. Kirkby followed by giving several new points on short wave reception.

### Dartford and District Wireless Society.*

Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Dartford.

The usual fortnightly meetings of the above Society were held on the following dates, Mr. J. R. Smith, A.M.I.E.E., Vice-President, in the chair, on each occasion.

Friday, February 24th, 1922.—This meeting was well attended and several matters appertaining to the Society's work were discussed. Several members produced sketches of valve circuits with a view to deciding a suitable circuit for completing a valve receiving set to be permanently installed at the Grammar School. An experimental set with sketches of circuit was demonstrated by Mr. Watt, and it was eventually decided to make up the Club set on these lines.

"H.T. Cells and Their Manufacture" was among the subjects discussed, the matter being treated more from an amateur than professional point of view.

The secretarial duties in connection with the Society having greatly increased, Mr. J. R. Prangnell was elected Assistant Secretary.

Friday, March 10th, 1922.—The minutes of the two previous meetings were read and confirmed at this meeting, and the Hon. Secretary also read a letter received from the Editor in connection with the new issue of *The Wireless World*, commencing on April 1st, next. A resolution was passed to the effect that the Hon. Secretary write a letter of thanks to the Editor for information, instructive and interesting, given in the past, and also best wishes for success of the weekly magazine.

The Hon. Secretary also read a letter from the Wireless Society of London regarding matters of importance discussed at the Conference of Wireless Societies. Good progress is being made with the Society's receiving set and it is hoped that same will be ready for test at the next meeting.

### Sheffield and District Wireless Society.*

Hon. Secretary, L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

On the 24th March at the Department of Applied Science, George Square, Sheffield, Mr. G. Hollingworth, of the National Physical Laboratory, gave a most interesting lecture on "Modern Wireless Problems," to a large and appreciative audience.

In a fluent and masterly manner he made clear many of the difficulties experienced in wireless research work and indicated their probable solutions.

In listening to the lecturer, one felt justly proud of the men who carry out valuable work so quietly and efficiently at the National Physical Laboratory.

The full discussion which followed showed the amount of interest taken by our members in all that appertains to radio activities and Mr. Hollingworth was evidently well pleased with the enthusiastic reception and hearty vote of thanks which he received.

### The Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting took place on March 24th at the Leeds University, Mr. A. M. Bage (Vice-President) taking the chair at 8 p.m. The Chairman called upon Mr. J. Croysdale to deliver his paper on "Accumulators and High Tension Batteries." Mr. Croysdale arranged his lecture so that the junior members as well as the more advanced members should have benefited considerably as a result of his remarks. He explained in a very clear and concise manner the theory of the accumulator, paying special attention to lead cells. Passing on to high tension batteries, the lecturer recommended the use of small primary cells in order to obtain anode potential. He had constructed a very successful wet primary battery of Leclanche cells, using the sacks and carbons of old dry cells in place of the usual porous pot. Cylindrical zinc sheets formed the negative pole. The containers were made from waxed cardboard. Such a battery was stated to be very silent even with L.F. valves, and was extremely durable. A specimen of these cells was passed round for examination. At the close of the lecturer's remarks, the Chairman declared the discussion open, which was joined into freely

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by the meeting. A hearty vote of thanks was accorded to Mr. Croysdale.

The Chairman then called upon Mr. S. Kniveton to deliver a paper entitled "Home-Made Three Valve Amplifiers." Mr. Kniveton had on view two three-valve sets which were almost entirely home-made. One set included a stage of H.F. magnification with reaction, a rectification stage, and a L.F. magnification stage. With this set it is possible to use the rectifier alone, or in conjunction with the H.F. valve and/or the L.F. stage. The H.F. intervalve transformer is "tuned" by means of a condenser and functions successfully over a wide range of wavelengths. This inductive coupling is displaced on the longer waves by resistance capacity connections, the change-over being made readily by use of valve pins and sockets. Diagrams of connections were distributed to those present. The other three-valve set was not a complete receiver in itself, and was used as a L.F. amplifier. Switch-gear, which consists of one multiple pole switch, does all the necessary making and breaking of the circuits when one desires to use a certain number or combination of valves. At the cessation of the lecturer's remarks the discussion was opened. This gave rise to some very interesting practical points, which were gone into further, when, after a hearty vote of thanks had been given to Mr. Kniveton, the meeting broke up to examine the apparatus on view.

The Chairman had three variable condensers with ebonite dielectrics on view, these instruments being home-made also.

**Birmingham Experimental Wireless Club.***

Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham.

At a meeting held at Digbeth Institute on February 17th, the Hon. Secretary gave a short talk on the conversion of obsolete "Crystal" sets for valve work. A partially-converted Marconi "Type 31" receiver was exhibited and passed round for inspection. A description was also given by Mr. Adams of the methods he had employed in converting a "Type 16" receiver.

A discussion took place, the merits of different types of coils being argued by their respective supporters.

A meeting was held at Dibgeth Institute (the Club headquarters) on March 3rd. The Hon. Treasurer, Mr. A. Woodcock, gave a very instructive lecture on "Recording Wireless Signals." The lecture, which was much enjoyed, was very practical, and included descriptions of original ideas of Mr. Woodcock's own invention. The lecturer has devoted many months to research in this direction and has had great success. On conclusion he was accorded a hearty vote of thanks, and was asked many questions concerning the circuits and relays used in his experiments.

**Bradford Wireless Society.***

A meeting was held in the Club-room at 7.45 p.m. on March 24th, Mr. W. C. Ramshaw in the chair. After the business of the meeting, the Chairman called upon Mr. T. Brown-Thompson to give his lecture entitled "Types of Valves."

In a very lucid manner the lecturer dealt with the Theory of Valves from the inception up to the present day. The lecture was admirably illustrated by diagrams and also a series of characteristic curves of various types of valves, including the N.P.L. and Weagant type. Touching upon the Four Electrode Valve, Mr. Thompson explained how its action depended upon "the Secondary Emission of Electrons from the Plate." This portion of the lecture was of immense interest to those present, judging by the number of questions asked at the close of the lecture and which were adequately replied to by Mr. Thompson.

At the conclusion a hearty vote of thanks was proposed by Mr. Evans, seconded by Mr. J. Bever and carried unanimously.

After the lecture a demonstration of Messrs. Burnham's "Ultra III" set was given, good signals being obtained.

Meetings take place every alternate Friday evening at 7.45 p.m. in the Club-room, 5, Randall-well Street (just above the Empire), Bradford. Next meeting, April 21st.

Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

**Croydon Wireless and Physical Society.***

On Saturday, March 4th, the above Society paid a visit to the Croydon Aerodrome and had an opportunity of inspecting the W.T. Station, the Flying Ground, Meteorological Dept., etc. Some of the members took advantage of the occasion and had a short flight.

The Society owes a deep debt of gratitude to Capt. Guest and the members of his staff, who so kindly explained all the important points connected with the working of the Aerodrome.

The members afterwards had tea at the Greyhound Hotel, Croydon, and all decided that they had spent a very enjoyable and instructive afternoon.

A few members of the Anerley Wireless Society were also present at the Aerodrome and tea.

The Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley, will be glad to receive applications from intending members.

**Plymouth Wireless and Scientific Society.***

On Wednesday, March 8th, a sale of apparatus was held. Quite a quantity of "old junk" appeared and a considerable amount changed hands. The sale took the form of a Dutch auction, and Mr. Graves proved an efficient and valuable auctioneer.

The following Wednesday we were favoured with a most interesting and instructive lecture on "The Electron Theory," by Mr. Mitchell. This subject led to a lively discussion on some of the points raised, among others the vexed question of which way a current flows. A very enjoyable evening was spent, and a hearty vote of thanks was accorded to the lecturer.

On Wednesday, March 22nd, the Secretary gave a lecture on X-rays. The phenomena accompanying the electrical discharge through air at decreasing pressures, the formation and probable structure of the cathode stream, and ultimately the formation of the X-rays were described. Reference was made to the experiments and investigations of J. J. Thompson, Sir William Crookes and Professor Röntgen. At the conclusion of the lecture, by means of a tube he had brought and a 10-in. coil belonging to the college, the Secretary gave a demonstration, and curious members were enabled to investigate one another's anatomy.

Full particulars of the Society will be furnished upon application to the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

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### The Wireless Society of Hull and District.*

Mr. W. J. Featherstone presided at the fortnightly meeting of this Society in the absence of the President and Vice-President.

After the minutes of the previous meeting had been read and confirmed a member brought forward a proposal that the Librarian of the Central Library be written to, with a view of ascertaining if it was possible for a copy of the "Year Book of Wireless Telegraphy and Telephony, 1922," to be placed in the Reference Library for the use of wireless enthusiasts in Hull, who wish to consult such a work at any time. This was duly seconded and carried, and the Hon. Secretary was instructed to write accordingly. The rest of the evening was profitably occupied in taking down code and press, the Chairman ably manipulating the buzzer at various speeds.

The Hon. Secretary, 16, Portobello Street, Hull, would welcome more intending members, and will be only too pleased to furnish full particulars on request.

### The Willesden Wireless Society.*

At our meeting on March 7th Mr. T. Key lectured on galvanometers, giving his interested audience descriptions of the various kinds in use and information for making and using a simple but sensitive instrument. The lecturer was accorded a very hearty vote of thanks. On March 14th Mr. W. Jones gave an elementary lecture upon "Magnetism and Electricity," it was received very well, especially by the newer members, and it has been decided to give elementary lectures and talks to the non-technical members every Friday in addition to the usual Tuesday meetings. Mr. A. Arnoll has kindly undertaken the teaching.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. Cutler, 24, Floating Bridge Road, Southampton.

At a meeting of the above Society held at the, Kingsland Assembly Rooms, on Wednesday March 15th, a large and enthusiastic gathering of members was recorded. Buzzer practice was indulged in for 30 minutes, after which Mr. Cutler's three-valve set was on exhibition for members, and was the centre of attraction. Leafield was tuned in at 8 o'clock and was heard with remarkable loudness all over the large concert hall. Various other stations were tuned in, and the signals were all that could be desired. At 8.45 general business of the Club commenced. Rules, etc., were passed and the Club put on a proper working basis.

On March 22nd a most enjoyable and pleasant evening was spent and a large attendance of members was recorded. The evening was devoted to experimental and research work, demonstration on a three-valve L.F. receiver, and also a three-valve amplifier. A Club receiving set will shortly be installed and also, it is hoped, a C.W. transmitter.

The following are the officers of the Society :—*Chairman*, Mr. R. Freeman; *Vice-Chairman*, Mr. Eastman; *Hon. Secretary and Treasurer*, Mr. T. H. Cutler. *Committee*, Messrs. C. Callanan, R. Reeves, J. Knott, R. Spear, F. Wainsboro. *Auditors*, Messrs. R. Francis, M. Oxford. *Trustees*, Messrs. C. A. Hopkins, C. D. Medley.

Meeting every Wednesday, 7.30 p.m.

### Wolverhampton and District Wireless Society.

A meeting of the above-named Society was held on Wednesday, March 22nd, at Headquarters, 26, King Street, Wolverhampton. A very interesting demonstration on a B.T.H. Portable Set and loud speaker was given by Mr. H. Taylor. The Leafield Station was particularly assertive, but other more modest stations were heard quite well, and with the aid of an outside aerial Annapolis could be received. A practical illustration of "jamming" was afterwards given by Messrs. Taylor and Jones, the latter using a converted Mark III set.

Hon. Secretary, Mr. Geo. W. Jones, 8, Roseberry Street, Wolverhampton.

### Smethwick Experimental Wireless Club.

Hon. Secretary, Mr. Ralph H. Parker, Radio House, Wilson Road, Smethwick, Staffs.

At a meeting held on February 17th, at the Club's headquarters, Municipal Technical Institute, Mr. L. Lee gave a very interesting lecture on "High Frequency Transformers for Long Wavelengths," followed by a demonstration of a three-valve set of his own structure. The lecturer was accorded a hearty vote of thanks.

A meeting was held on Friday, February 24th, Mr. A. C. Hulme in the chair, and after the previous minutes had been read and confirmed, the Secretary kindly lectured on the "Evolution of the Valve."

Starting from the investigations made by Ebster and Geitel, 1882-89, he outlined the evolution of the modern three-electrode valve. Judging from the discussion which followed, his lecture proved to be beneficial to all. Mr. C. Grew proposed a vote of thanks which was carried with acclamation.

At a meeting held on March 3rd Mr. C. Grew gave a demonstration on his four-valve receiver which was greatly appreciated.

The Club has now procured a Tingey receiver and hope to arrange a demonstration.

### North Essex Wireless Society.

Hon. Secretary, Mr. F. J. Smith, Rutlands, Felsted.

Pending arrangements for a permanent Headquarters and Club-room, informal meetings of members are held at 15, Rayne Road, Braintree, every Saturday evening from 7 to 10 p.m., and the Secretary, Mr. Castagnoli, is in attendance. It is hoped by this means to arrange for the future of the Society and to arrange an interesting programme. The first meeting was held on Saturday, March 18th, and was devoted to a discussion on "Wireless" topics.

### The Wireless Society of East Dorsetshire.

A lecture, principally for beginners, was given in the Wimborne Council Schools on Wednesday, 22nd March, by the Secretary on Crystals and the practical application to receiving circuits, with explanations of the fundamental principles of oscillations.

Members are notified that these lectures will continue to be held monthly, the next be fixed for April 19th.

Members and enthusiasts in the Poole and Branksome districts are invited to meet and use the Branksome Liberal Club as Headquarters, *pro tem.*, on notifying the Secretary, Mr. T. Chapman, Associate I.R., Abbotsford, Serpentine Road, Poole, who will also be glad to hear from any amateurs wishing to become members.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) Four questions is the maximum which will be accepted at a time.*

**C.S.B. (Cullompton)** *asks (1) The best way to add two valves to a single valve set. (2) If a single valve set radiates much. (3) What results to expect with additional valves.*

(1) and (2) It will be much better to add one H.F. valve with resistance capacity coupling, and one L.F. magnifier to the present oscillating detector valve. **PCGG** will then be much stronger.

(3) This circuit does radiate feebly, and the "seven valve man's set" cannot be very efficient if he could not detect it. Normally this feeble radiation does not cause much interference unless there are several stations close together on the same wavelength.

**H.P. (London)** *asks (1) If a 3-valve transformer coupled set will work satisfactorily. (2) Which is the rectifying valve, and why.*

(1) Set will be better with reaction coil in the grid of the third valve. 4-volt filament may be lighted from the 6-volt cell if extra resistance is added in the circuit.

(2) All the valves are rectifying somewhat, but the third valve is the main rectifier, chiefly because the circuit arrangement permits the previous H.F. valves to amplify, but does not allow the last to do so.

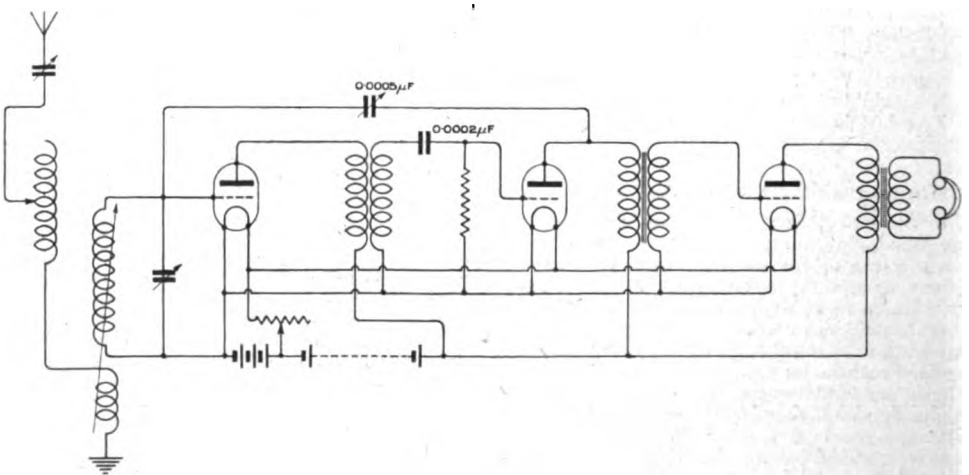


*Fig. 1.*

**"ELECTRON" (Elland)** *has a collection of apparatus and asks (1) For a suitable circuit. (2) Where to use an "Ora" valve. (3) If* **PCGG** *will be heard on a set in Yorkshire. (4) If additional apparatus is required.*

(1) and (4) See diagram Fig. 1.

(2) Use it as rectifier.

(3) Yes, if the H.F. transformer is suitable for 1,050 ms., and the adjustment of the circuits very carefully carried out.

**"NIPPER" (Poole)** *hears clicking noises on his crystal set, and asks for advice.*

These are probably signals from the high power C.W. station at Leafield on harmonics as well as the fundamental of its wavelength. Or possibly the source may be some nearer C.W. station. In either case you will have difficulty in tuning them out.

**G.W.M. (Croydon)** *asks for particulars of a loose coupler for 4,000 ms., and a loading coil for longer waves.*

If a 0·0003 mfds. condenser is used across the secondary, the following windings should be satisfactory. Primary 6″ × 12″, wound with No. 24. Secondary 5″ × 10″, wound with No. 28. No loading coil will be of any use, as there are no spark stations working on longer wavelengths, except MSK.

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**"INTERESTED" (Walford)** *asks for the essential parts of a receiving station for* 600 *to* 30,000 *metres.*

A single valve set would be best, and for this wavelength we should advise slab coils. You would obtain better results with more valves up to 2,000 metres. The following parts will be required.

1 Valve.
1 6-Volt accumulator.
1 50-Volt dry cell battery.
1 3-ohm filament resistance.
1 Pair telephones.
1 0·001 Mfd. condenser.
1 Grid condenser and leak.
1 0·0005 Variable condenser, together with tuning and reaction coils.

**"J.K." (Hillingdon)** *asks* (1) *Wavelength to which certain coil will tune.* (2) *Number of turns on* 3″ *former for* 1,200 *metres.* (3) *If two basket coils connected as a variometer gives sufficiently fine tuning for telephony.*

(1) Inductance is 2,400 mhys, and it will tune a standard aerial to about 1,300 metres.

(2) About 300 turns of No. 26 with a reaction coil 2½″ diameter wound with 4″ of No. 28.

(3) This should be quite satisfactory.

**"E.R.M." (Inverness)** *has a two-valve spark set which oscillates above* 3,000 *metres. He asks* (1) *why this is.* (2) *What stations precede messages by* "PR" *and a number.*

(1) This may possibly be due to capacity reaction due to leads from the plates and grids of the valves being run too near together. Try separating them. It is possible that interference from Stonehaven or Aberdeen C.W. sets may cause your set to appear to oscillate.

(2) "PR" is a Service signal.

**"WOLF" (Wolverhampton)** *asks* (1) *For diagram of the M.*15 *receiver.* (2) *How to attach an additional note magnifier.*

(1) We regret we do not possess this diagram, but you will be able to obtain it from the makers, or you could trace it yourself by taking off the bottom of the instrument.

(2) Introduce the step-up iron core transformer between the telephone terminals and the grid and filament of the magnifying valve.

**"AMPLIFIER" (Norwich)** *Is constructing a four-valve set and asks for advice.*

(1) The reaction connection is correct. Connect a 0·001 mfd. condenser across the telephones.

(2) 40,000 Ohms should be sufficient for a plate resistance for these valves. If a valve requires 30 volts on the plate for normal working it will require about 60 when used with a resistance in this way, owing to the big volt drop across the resistance.

(3) The intervalve condensers should be about 0·0003 mfds. The condenser across the potentiometer about 0·05 mfds. Make the intervalve condensers up with two foils overlapping for about 8 square centimetres separated by a 2 mils. sheet of mica.

(4) A potentiometer should be wound to several hundred ohms with No. 36 Eureka wire. This potentiometer is not strictly essential.

**"CARBORUNDUM" (Monkseaton)** *asks* (1) *For relative values for inductances and condensers in a two-circuit set.* (2) *If in his set the aerial is liable to oscillate.* (3) *If there is any likelihood of damage to the* 4,000 *ohm telephones in a* 50*-volt circuit.*

(1) Generally speaking the inductances and capacities can be the same in each. In your case both condensers should be 0·0005 mfds., A.T.I. 8″ × 6″ of No. 22, closed circuit inductance 6″ × 5″ of No. 28.

(2) As you show no reaction the aerial will not oscillate, but if you couple back from the closed circuit into the A.T.I. you will get oscillation which can only be stopped by loose coupling.

(3) There is no danger, particularly as you have a crystal in series with the telephones.

You may get **PCGG** very weakly if you use reaction. You should get **FL** on telephony.

**"G.H.B." (New Cross)** (1) *Queries the dimensions given for condensers in the single valve set described in March,* 1921. (2) *Asks if DCC wire may be used instead of DSC.* (3) *If a multi-valve H.F. amplifier may be used with this set without alterations to the connections, and, if so, for a diagram.*

(1) For the 0·0015 mfd. condenser five foils will be sufficient. The other value was given in error.

(2) DCC may be used but will curtail the range somewhat owing to the greater thickness of the wire.

(3) The set is not suitable for this alteration without complete re-arrangement. The tuning circuit can be used for any of the multi-valve circuits shown recently.

**"P.C." (Watford)** *asks re the reply to* **"C.C.W." (Woolwich),** *in January 7th issue.* (1) *The total number of turns of wire for each coil.* (2) *For a diagram of connections.* (3) *The wavelength of the set.* (4) *How to determine the wavelength of slab-coils.*

(1) We fail to see the use of this information, but the A.T.I. will contain about 300 turns; coupler primary 120 and coupler secondary about 400.

(2) See diagram Fig. 2.

(3) Maximum about 3,000 metres.

(4) There is no simple rule, but you will find a formula which gives fairly good results for close-wound coils on page 22 of Nottage's "Calculation of Inductance and Capacity."

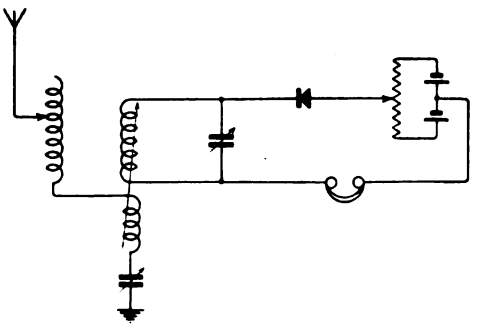

*Fig. 2.*

**"H.G." (Sparkhill)** *asks* (1) *What results, if any, he will get with certain gear.* (2) *For a diagram of connections.* (3) *For a suitable aerial.*



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(1) You should get fair results from any near station and should also get **FL** and Poldhu.

(2) See diagram Fig. 3.

(3) Aerial should be as high and long as possible. Results will be poor unless it is practically the P.M.G. maximum.

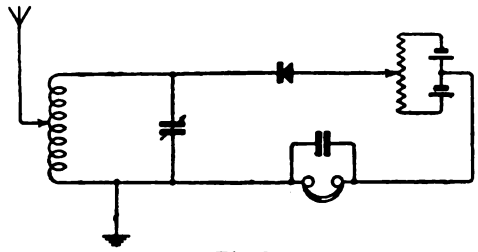

*Fig.* 3.

**"ACK-ACK" (Greenwich).**—As you do not specify sufficiently clearly what set you are referring to we cannot answer in detail. A 6-volt accumulator is sufficient for "V.24" or "R" valves. The filament resistance should be used in either case. Failure to oscillate is probably due to insufficient reaction. The capacity across transformer primary may be 0·0001 mfd. if transformer is H.F., and 0·001 mfd. if L.F.

**"H.M." (Stamford Hill)** *asks* (1) *Dimensions for rotary condensers for school set described in October 29th issue.* (2) *Best value of grid leak for this set.* (3) *If he can receive* **PCGG** *with it.*

(1) Only one condenser will be necessary. It should have 12 fixed plates and 11 moving; 4" diameter, space 1/16" apart.

(2) About 5 megohms, but the best value must be determined by experiment.

(3) You may get this station very weak with careful tuning.

**"W.F." (Romford)** *asks* (1) *For windings for a single circuit reaction tuner for about* 150 *metres.* (2) *Where to put tappings for certain wavelengths.*

(1) Wind the 3½" × 6" former with No. 22 for the A.T.I. and the 3" × 5" with No. 28 for reaction. Use the 0·0005 mfd. condenser, which must be of variable type, in series with the A.T.I.

(2) It is impossible to predict tappings accurately on a set of this type, and in any case you will not require more than two or three to each coil.

**"L.J.E." (Kingston)** *asks whether a tuner with basket coils has been described in any previous issue, and if not, for the date of an issue describing a good all-round set.*

A slab inductance tuner is described in the issue for October 15th, 1921, on page 438. A more ambitious set is described in the September 3rd issue, page 344.

**C.G. (Clapham)** *asks* (1) *If a* 4*-valve circuit diagram is O.K.* (2) *For switching connections to vary the number of valves in use.* (3) *If the capacity reaction connection is correctly shown.* (4) *For suggested improvements.*

(1) Yes.

(2) A switching arrangement suitable for varying the number of L.F. valves is shown in the circuit given to **H.W.K. (Greenwich)** above.

(3) Yes.

(4) Whenever an iron cored transformer is placed in an H.F. circuit it should have a small condenser 0·001 mfds. across the winding in the H.F. circuit.

**"GRATEFUL" (Lytham)** *asks* (1) *For criticism of a set.* (2) *For particulars of a variometer to give exactly* 2,600 *ms.* (3) *Diagram of a Mark I tuner.* (4) *Method of calculating capacity.*

(1) Set will be O.K. if the reaction condenser is kept very small, say 0·00005 mfds.

(2) Determination of a variometer to fulfil such a requirement is quite impossible by calculation. It could only be done by experiment.

(3) See page 64 of this issue.

(4) Capacity $= \frac{nKa}{4\pi d.900000}$ mfds.

where $n$ is the number of sheets of dielectric.
$K$ is the specific inductive capacity of the dielectric.
$a$ is the overlap of the plates of opposite polarity, in sq. cms.
$d$ is the thickness of the dielectric in cms.

**"WARWICK" (Berkswell)** *shows two circuits, both transformer coupled valve sets, and asks* (1) *Why neither of them give* **PCGG.** (2) *Why four of a certain set of slab coils do not give any results.*

(1) As you give no particulars of aerial circuits or transformers, we cannot say for certain. Apart from the fact that very careful adjustment and tuning are required for this station it is very probable that the natural wavelength of the transformers is unsuitable for 1,100 metres.

(2) This is probably due to a few turns being short-circuited in the coils. This is a common defect in coils of this type now offered and is fatal to good reception.

**"ENTHUSIAST" (Enniskillen)** *sends a circuit for criticism and asks* (1) *For amended diagram to cover addition of another valve and crystal rectification.* (2) *If grid condenser could be variable.* (3) *If he would have difficulty in obtaining a licence.* (4) *If a frame aerial will be of any use with the set as altered.*

(1) The set is all right as shown except that we do not like coupling through both the slab coils and the loose coupling. For amended diagram see page 398, September 17th issue.

(2) Grid condenser may be variable up to a maximum of 0.0003 mfd.

(3) We do not know. Write to the Secretary of the G.P.O.

(4) You may get fair results with ship stations in the Irish Channel.

**"G.W.D." (Durham)** *asks re the frame aerial set described in No.* 16 *to* 21, *Vol.* 8 (1) *If Burndept coils may be used in place of the coils described.* (2) *If a* 0·005 *mfd. variable condenser may be used in place of the fixed condensers.* (3) *If Mullard "Ora" valves may be used in place of "V.*24*."* (4) *If the wavelength will be seriously altered by these changes.*

(1, 2 and 3) Yes, in each case.

(4) No. If the Burndept coils have the same inductance as those for which they are substituted.

**"C.M.B." (Nice).**—(1) Make the aerials as high as possible whatever the length may be.

(2) Yes.

(3) Not appreciably, unless the hill is very steep.

(4) About four.

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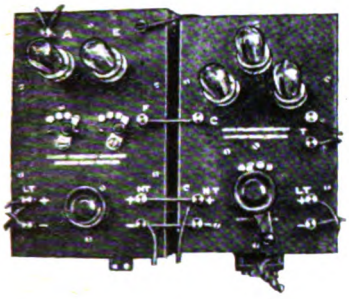
# MINIATURE PRECISION RECEIVERS

**AS SUPPLIED TO THE GLASGOW OBSERVATORY, UNIVERSITY OF GLASGOW, ETC.**



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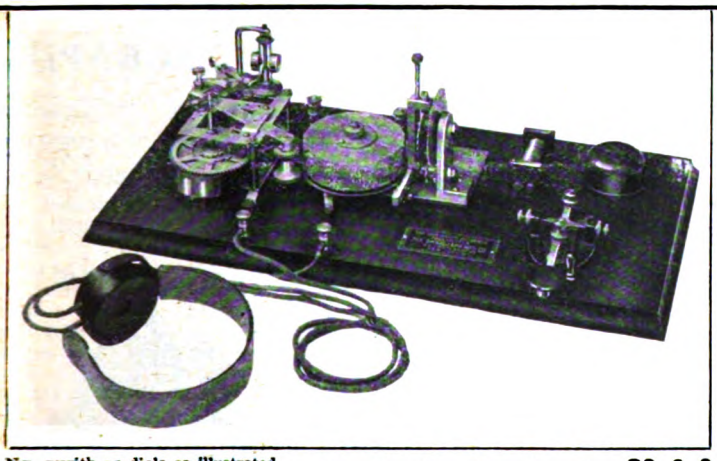

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| No. 1 with 15 dials as illustrated ... ... ... ... ... ... | £9 6 0 |
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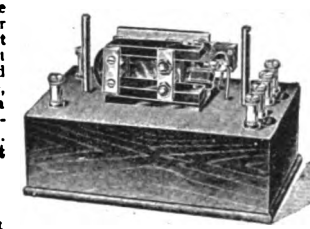
# THE "BROWN" MICROPHONE AMPLIFIER



This Amplifier magnifies signals, or music, without distortion, and is of considerable interest to amateurs and scientific investigators. The Magnification is much greater than that obtained from two valves, and the current consumption is about 50 milliamps. In construction, this instrument is simple, and it is much more robust than other sensitive relays of this class. This instrument satisfies the urgent demand for a reliable, inexpensive amplifier, which the most inexperienced amateur can use, and which the most experienced requires. It is much cheaper, ultimately, than a multi-valve amplifier, and the operator is relieved from many of the varied causes of breakdown. It includes a transformer suitable for low resistance telephones or loud speakers.

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With an Amplifier signals or telephony may be so magnified as to cause discomfort to wearers of head-phones, yet not be loud enough to be audible at any appreciable distance from the head. Every wireless experimenter sometimes wishes to let his friends hear, which would involve the use of several pairs of telephones simultaneously with consequent loss of signal strength, as well as considerable expense. The "Brown" Loud Speaker was designed to meet this need efficiently and economically, and is used in all up-to date receiving stations. The sound is intensified by means of a horn.

**The "Brown" Loud Speaker (120 ohms), Standard Pattern with Upright Funnel .. .. .. .. £5 10 0**
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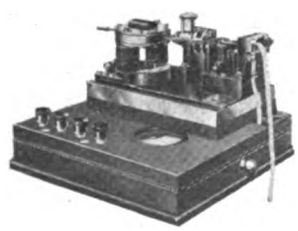

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"**H.D.**" **(Hornsey)** *asks* (1) *Whether a certain aerial will be suitable for use with a certain set.* (2) *When previous questions of his were answered.*

(1) Yes.

(2) February 18th, 1922, page 743.

"**KHABAR ANGIN**" **(Lew)** *asks* (1) *For criticism of set.* (2) *How to arrange for shorter wavelengths.* (3) *How to increase wavelength.* (4) *If adding a crystal will give* **PCGG**. (5) *How to attach a Morse inker.*

(1) Set is quite good as it stands.

(2) Put condenser in series instead of in parallel with A.T.I.

(3) Increase the capacity of the condenser to 0·005 mfd.

(4) This is possible; but if obtained, signals will be very weak indeed.

(5) Impossible without the addition of several valves.

"**B.H.E.**" **(Shoebury).**—(1) We believe that in this valve an increased grid potential still gives an increase of plate current.

(2) We do not think that these valves are obtainable in this country. Enquire of the De Forrest Company.

(3) We are unable to explain this effect entirely without a detailed examination, but the symptoms point to bad contact in the secondary winding of the transformer referred to, allowing the grid of the first valve to discharge intermittently.

"**RADIO**" **(Battle)** *is adding a H.F. valve to a single valve panel and asks* (1) *If an intervalve H.F. Transformer is necessary.* (2) *If grid condenser on panel should be shorted.* (3) *If results will be as good without a filament resistance for the first valve.* (4) *Relation between inductances in two circuits, if the condenser in the first is* 0.001 *mfd. and in the second* 0·0005 mfd.

(1) Transformer is necessary unless resistance-capacity coupling is used.

(2) Preferably leave it as it is.

(3) Yes, until the valve burns out, which will probably happen fairly quickly.

(4) Inductance in the second circuit should be twice that of the first.

"**A.H.S.**" **(Belmont)** *asks* (1) *How to arrange a tuner.* (2) *If a circuit sketched is O.K.* (3) *What results he is likely to get.*

(1 and 2) Arrange your circuit as in your sketch, which is quite correct except that a bigger capacity, say 0·001 mfd., should be used across the H.T. battery and telephones. Put the larger coil in the aerial circuit and keep the A.T.C. as low as possible at all wavelengths.

(3) You should get ships and land stations, spark and C.W. and also telephony up to about 2,500 metres.

"**INTERESTED**" **(Nottingham)** *sends diagram of set and asks* (1) *If he will get good results.* (2) *If we recommend any alterations.* (3) *How to make one valve H.F., and if this will be an advantage.* (4) *If his telephones are suitable.*

(1) Subject to alterations given below results should be very fair, but would be improved by one stage of H.F.

(2) For short wavelengths, put the A.T.C. in series with the A.T.I., also condenser between C and positive of H.T. should be between D and the H.T. battery. A potentiometer to the first grid will improve results.

(3) This can be simply done by making the first transformer H.F., omitting the condenser between D and the H.T.

(4) Brown's type "A" 2,000 ohms telephones will be suitable without transformer, although the resistance is rather low.

"**SELENIUM**" **(King's Lynn)** *asks* (1) *Approximate resistance of a Selenium cell in the dark and when exposed to light.* (2) *How much current will be passed through it by a 2-volts cell.* (3) *Resistance of a suitable relay for use with such a cell.*

(1) Depends on the type of cell. Is usually very high—say 20,000 ohms in the dark and 5,000 ohms in the light.

(2) This can be determined by elementary application of Ohm's law.

(3) Approximately the same resistance as that of the cell when exposed to light.

*N.B.*—These cells are very difficult to work with and we should advise you to consult special works on the subject before trying them.

"**J.M.**" **(Cadiz)** *asks* (1) *If the power radiated from an aerial depends only on the current in it.* (2) *For an explanation of a case in which the range was considerably increased without any considerable increase in the aerial current.*

(1) Yes, provided that no other factor is varied, but it does not follow that the range will be the same with different type sets because, for instance, one set may be radiating a wave much freer from harmonics than the other. A pure wave form will carry much further than a bad wave form. In your second case the substitution of C.W. for spark with the improvement in reception thereby made possible is quite sufficient to explain the increased range in one case.

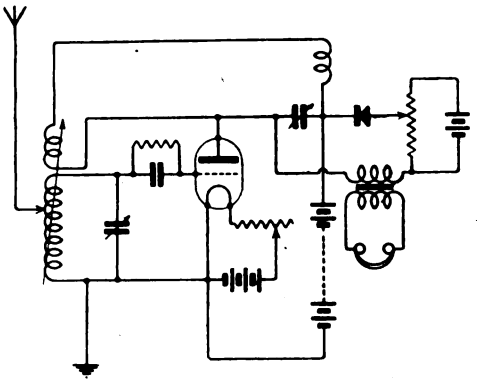

*Fig.* 4.

"**H.T.**" **(Cardiff)** *sends sketch of valve set and asks* (1) *How to add a crystal to it.* (2) *What additional apparatus will be necessary.*

(1) Circuit may be as in diagram Fig. 4, which will also show you what additional apparatus is necessary.

"**BOBBY**" **(Cardiff).**—(1) Make the reaction coil as big as you can and wind it with No. 30 wire.

(2) For a two-valve set with capacity reaction connect up the valves in any usual way and then introduce a condenser of about 0·00005 mfd. between the grid of the first valve and plate of the second.

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**"D.H.B.M. (Leicester)** *asks* (1) *For a three-valve circuit to meet with certain requirements.* (2) *Data for duolateral coil to be used instead of the pile wound coil in the single valve set described in the last volume.*

(1) One method of obtaining the required result is shown in the diagram, Fig. 5, but you will get better results with a simpler set.

(2) The No. 1 unit is best left as it is. For the No. 2 unit use a former about 3" in diameter, put on one thousand turns in about ten layers; tap the coil in the same proportions as before.

**"C.M.L." (Brighton)** *asks* (1) *How to eliminate induction from a heavy three-phase supply running past his house.*

We are afraid there is no known way of stopping induction of this sort in as bad a case as yours, particularly as you have found screening not successful. Your only hope is to move the set further from the cable.

(3) This condenser is necessary but there may, of course, be some other fault.

(4) You should get **PCGG**, but not if your set is oscillating.

**"T.W.J." (Huddersfield)** *asks what alterations and additions will be necessary to convert the separate heterodyne described in October 29th issue for use up to 9,000 metres.*

This can be done without altering the circuit by increasing the condenser C.7 up to about 0·002 mfd. and providing additional coils to bring the inductance L.7 up to 12,000 mhys., and the reaction coil up to about 5,000 mhys. It will also be necessary to increase the size of the pick-up coils. for long waves.

**"A.H." (Stone)** *asks* (1) *If it is possible to receive wireless telephony with a three-valve detector amplifier.* (2) *If so, the greatest distance signals will be heard with a "decent aerial."* (3) *The greatest distance telegraph signals will be heard.*

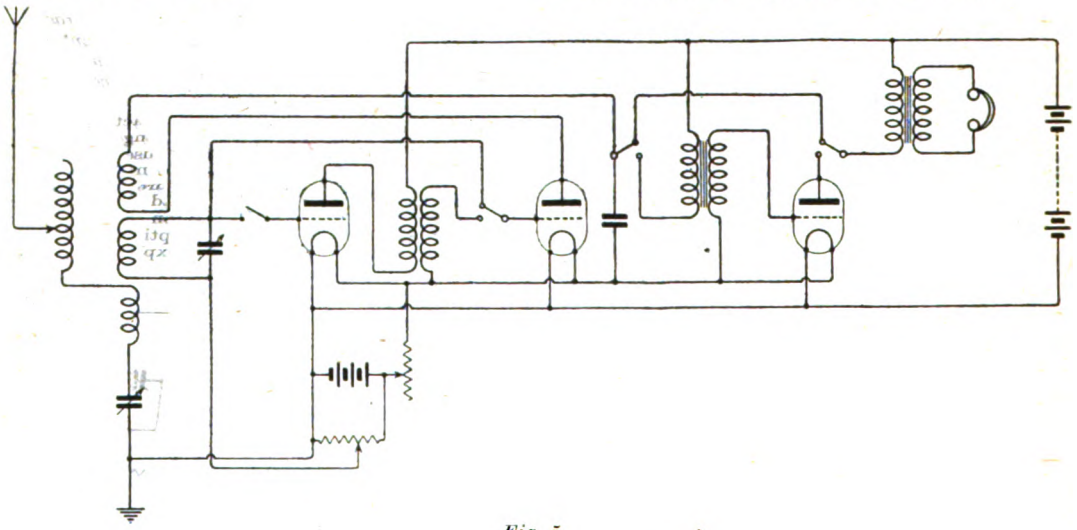

*Fig. 5.*

**"J.E.S." (Oundle)** *asks* (1) *What a variable vernier condenser is.* (2) *Approximate range of a crystal set.* (3) *What capacity to use with 7,000 ohm telephones.* (4) *What crystal combination to use.*

(1) This term is usually applied to a small variable condenser, capable of giving very minute adjustment to the capacity in a circuit.

(2) About 4,000 metres with the A.T.C. shorted

(3) About 0·0015 mfd.

(4) Carborundum for general purposes, or zincite-bornite for special sensitivity.

**"BILL" (Holt)** *asks* (1) *The best course to obtain a second-class P.M.G.* (2) *Correct values for coupling condensers in an L.F. resistance coupled amplifier.* (3) *Whether failure to oscillate in a circuit sketched is due to absence of a condenser across primary of an inter-valve transformer.* (4) *If it should receive* **PCGG** *when it oscillates.*

(1) A course of training at one of the schools advertising in *The Wireless World.*

(2) About 0·0005 mfd. as a rule.

(1) Yes, with suitable tuning circuits.

(2 and 3) Quite impossible to give ranges as there are various conditions, such as earth resistance of set and design of circuits which affect it considerably. With suitable circuits you should get British telephone stations, continental telegraph stations and possibly even American stations under favourable conditions.

**"SPARKS" (Bloxwich).**—(1) Rewind coil with No. 22 wire.

(2) Reduce capacity of condenser to not more than 0·002 mfd.

(3) Zincite-Bornite will be satisfactory.

(4) Tap the crystal and telephones across the inductance only, not the condenser as well.

**J.G.B. (Fife)** *asks if he can add three valves, resistance coupled, to an "M9" panel.*

Without a diagram of the panel it is not possible to advise you. There is no reason why additional valves should not be added. Ascertain wiring diagram and if necessary, amend to fit in with one of the many circuits given in *The Wireless World,* or seek advice from the makers.

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"**H.J.M.**" **(Thetford)** *refers to the transmitting circuit on page* 671, *January* 21*st issue, and asks* (1) *The range of the set.* (2) *Capacity of condensers.* (3) *The H.T. and L.T. voltages.*

(1) For amateur purposes the power is limited to 10 watts and the range is therefore also limited. With a good receiver a range of 20 miles telephony will probably be obtained; C.W. range will be considerably more.

(2) Condenser across the microphone transformer may be 0·001 mfd., and that across the H.T. about 0·005 mfd.

(3) L.T. 6 volts, H.T. about 100 volts.

"**H.S.**" **(Slough)** *asks* (1) *For the windings for a coupler for a reaction circuit.* (2) *Windings for iron core chokes for sets described on page* 533, *November* 25*th issue.* (3) *The difference in efficiency between a single strand and a seven strand aerial wire.*

(1) For the A.T.I. 6″ × 10″ of No. 24 wire. Reaction coil 5″ × 8″ of No. 28.

(2) We have no further information regarding these sets, but for long waves a coil similar to a telephone transformer secondary should be satisfactory. A smaller coil may be used for short waves.

(3) The stranded aerial will certainly be more efficient than the single wire, but the improvement will not be very great unless all the aerial circuit is similarly stranded. It is impossible to give a figure for the improvement.

"**PROSPECTIVE**" **(Dublin)** *asks for information regarding the* 50 *watt D.C. Trench Set.*

This is a combined short wave transmitting and receiving set. Transmitting wavelengths are 350 to 450 and 550 metres on an aerial smaller than the P.M.G. The spark coil is worked off a 10-volt accumulator, maximum transmitting range 5 to 10 miles. It has a two-circuit receiver; the secondary inductance with a 0·0005 mfd. air condenser across it being coupled to the transmitting A.T.I. Its wavelength range is from 300 to 600 metres, and it is therefore only useful for spark signals from ships.

"**W.R.G.P.**" **(Droitwich)**—See reply to "**Prospective**" **(Dublin).** Increase the height of the aerial above 12 feet, if possible. The telephone lines should not affect your signals seriously.

"**M.D.V.S.**" **(Putney)** *has a crystal set on which he cannot get any results. He asks for advice, etc.*

Your set is only suitable for short waves up to about 1,500 metres. You should get ships and Croydon telephony. The fact that you are using 60 ohm telephones probably explains lack of results. The transformers advertised will be suitable if they are telephone and not intervalve type. Connect the high resistance winding in the crystal circuit and the low resistance to the telephones.

"**ANNAPOLIS**" **(Coventry)** *wishes to use an indoor aerial in a room about* 50 *ft. long, and asks if suitable for crystal or valve reception.*

You might get a few very weak signals on a crystal set, but it would be better to start with at least two valves.

"**P.McM**" **(Cricklewood)** *asks* (1) *If a single valve diagram shown is correct.* (2) *How to improve it.* (3) *Whether to use home made slab coils or single layer coils for* 4,000 *metres.*

(1) and (2) Connections are correct, but set will be greatly improved by a reaction coil which will enable you to receive C.W. Either type of coil may be used. If the range is not to exceed 4,000 metres, and compactness is not essential, we somewhat prefer single layer coils.

"**P.J.W.**" **(Durrington)** *asks for a diagram of a* 5*-valve set.*

The diagram does not convey much information, we therefore refer you to an article by Mr. Campbell Swinton in the June 25th issue, on a 6-valve set. If you omit one of the H.F. valves the set will then be of the type you require. It should be capable of very good results.

"**D.U.D.**" **(Barnes)** *asks for information about a crystal set.*

The coils you describe would probably give fair results, but we should much prefer single layer coils on formers of reasonable size, say 4″ to 6″ diameter, for crystal work. Galvanised iron wire is very bad for an aerial; use copper or bronze. Earth the telephone side of the A.T.I. to the nearest water pipe. Half a jar is quite sufficient capacity for this circuit. Set should be useful up to 3,000 metres.

"**R.G.T.**" **(Fulham)** *asks* (1) *For criticism of* 2*-valve circuit.* (2) *Why the Air Ministry on* 1,680 *metres is received on* 650 *metres.* (3) *Effect of a small condenser in the grid of the first valve.*

(1) The set would be much improved if the reaction coil were connected in the plate of the second valve without its variable condenser. If "R" valves are used with resistance capacity coupling the H.T. should be at least 80.

(2) This is because the station radiates a harmonic on exactly half its normal wavelength. It is this harmonic you are receiving. Most C.W. sets radiate harmonics to a greater or less extent. They are generally much weaker than the fundamental and therefore are only noticed quite close to the transmitter.

(3) Would cause the first valve to rectify, but would probably not improve the set much.

"**R.J.P.**" **(Acocks Green)** *wishes to make a loose coupled tuner for* 300 *to* 1,200 *metres with a* 0·0003 *mfd. condenser and two ebonite formers.*

For a loose coupler with reaction you will require three ebonite formers. Wind A.T.I. 7″ × 5″ with No. 20. Closed circuit inductance 4″ × 4″ of No. 26; reaction 3½″ × 4″ about 30. Dead end effects will not be a nuisance on such short wavelengths, and you will therefore not need switches to minimise them.

"**R.J.G.**" **(Dovercourt)** *asks for criticism of valve and crystal set.*

The set should work satisfactorily without the crystal, but we should prefer to take the lower end of the loading coil to the slider of coil B, keeping the whole of coil B across the variable condenser. This will allow weaker coupling to be used. The set would be much improved by the addition of a reaction coil. The coil should be 3″ × 6″ of No. 28, sliding inside B. Reaction coil should be between plate of valve and positive of H.T.

"**A.G.**" **(Sutton)** *asks* (1) *For a single valve circuit.* (2) *If water-pipe connection is sufficient for an earth.* (3) *If twin flex would be suitable*

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*for earth and aerial leads.* (4) *Wavelength range of set.*

(1) See diagram.

(2) Yes.

(3) If used, the strands should be separated. It is undesirable to run aerial and earth leads as close together as the two wires of a flex.

(4) With the small coil you suggest the maximum wavelength will only be about 1,500 metres.

**"H.N." (West Bromwich)** *has a single valve set and asks how to improve it for receiving telephony.*

The simplest way of doing this will be to add one or two valves as L.F. magnifiers. Details of construction of such magnifiers are given in May 28th and June 25th issues. We are unable to say why you do not get telephony without more detailed information about your set.

**"V.526" (Australia)** *asks* (1) *For a formula of honeycomb coils.* (2) *For criticism of single valve short wave set.*

(1) A good formula is as follows :—

$$L \text{ (microhys)} = \frac{4\pi^2 a^2 N^2}{b + c + R} \times F_1 F_2 \times \frac{1}{1000}$$

where "$a$" is the mean radius of the winding, "$b$" is the aerial length of the coil, "$c$" is the thickness of the winding, "$R$" is the outer radius, "$N$" is the total number of turns.

$$F_1 = \frac{10b + 12c + 2R}{10b + 10c + 1{\cdot}4R} \text{ and}$$

$$F_2 = 0{\cdot}5 \log_{10} \left\{ 100 + \frac{14R}{2b + 2c} \right\}$$

We should not care, however, to guarantee the accuracy of this formula to within 20 per cent. for any particular case of this sort of coil.

(2) As you show it this is a transmitting circuit. For the correct circuit see reply to **"A.G." (Sutton).**

**"ARPON" (Bangor)** *wishes to use a public electric light supply for purposes of experimenting in electricity and magnetism and asks for advice.*

This question, which does not relate to wireless in any way, is hardly within our scope. You will be well advised to buy an elementary text-book on practical electricity, and use dry cells for your experiments instead of a power main. We doubt if you will pass the London Inter Science at all easily if you do not know that D.C. supply cannot be transformed with a transformer.

**"H.J.B.P." (Edinburgh)** *asks if a "dancing contacts" relay sketched is likely to be efficient.* (2) *If rubber suspension of the relay would be advisable.* (3) *For a diagram of a 3-valve impedance amplifier.*

(1) The scheme suggested appears feasible, but will probably require a good deal of experimental development to obtain satisfactory proportions of the parts. We should be interested to hear the results obtained.

(2) We should certainly advise this.

(3) Diagram will be exactly the same as for resistance amplifier with a substitution of chokes for the anode resistances. We think you will find finer wire than No. 36 desirable for very long wavelengths. We would suggest 2 ozs. of No. 40 or No. 42 on an iron wire core ¼" in diameter.

**"F.A.P." (High Wycombe).**—(1) 0·001 mfd.

(2) Core ¼" diameter by 3" long of iron wires; primary 1 oz. of No. 44; secondary 3 ozs. of No 44.

(3) Either type may be used.

(4) You cannot get a range of 300 to 20,000 metres on one coil. You should make, or buy, a set of honeycomb coils for such a range, the biggest having about 1,000 turns with a mean diameter of 3".

**AERIAL (Camberley)** *asks* (1) *For a single valve diagram.* (2) *If slab inductances may be used with a crystal detector.*

(1) See page 584, December 10th issue.

(2) Yes, if efficient slabs suitable for wavelengths below 4,000 ms. are selected.

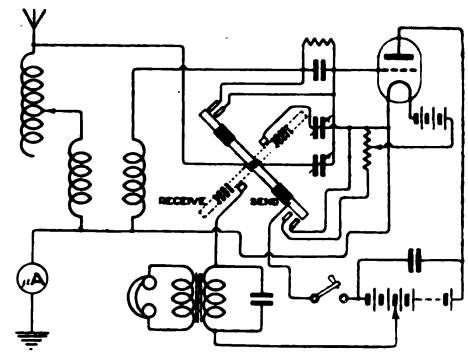


*Fig.* 6.

Diagrams (Figs. 6 and 7) show the connections of the Mark I. and Mark I.** R.A.F. Combined Transmitter and Receiver, and are given for the benefit of those who have recently asked questions relative to the manipulation of these sets.

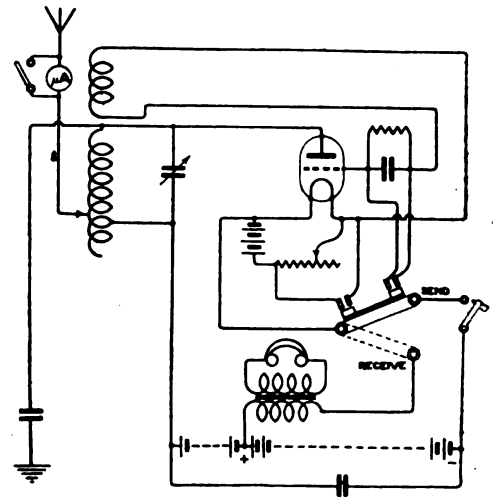


*Fig.* 7.

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THE
# WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 3. APRIL 15TH, 1922 WEEKLY

## Königswusterhausen

THE present high-power radio station at Königswusterhausen which belongs to the Post Office has developed from one originally designed by and built for the Military Authorities. Immediately upon the cessation of hostilities the postal authorities decided to relieve the telegraph lines by the institution of a wireless network. A considerable part of the telegraph business is now carried in this way. Königswusterhausen was taken over and fitted up as the central transmitting station for Germany and the neighbouring states, leaving Nauen and Eilvese to handle the transoceanic business.

Other transmitters must carry out the broadcasting, and others of higher power the communication with Rome, Budapest, etc.

In order to be able to work duplex, the receiving station is situated at Zehlendorf, 20 kilometres from Berlin. Special cables connect both transmitting and receiving stations with the Central Telegraph Office in Berlin, where the transmitting keys and recorders are actually operated.

In order to carry out this multiplex and technically difficult programme, it was necessary to instal a number of independent transmitters with their respective antennæ in a relatively small area.

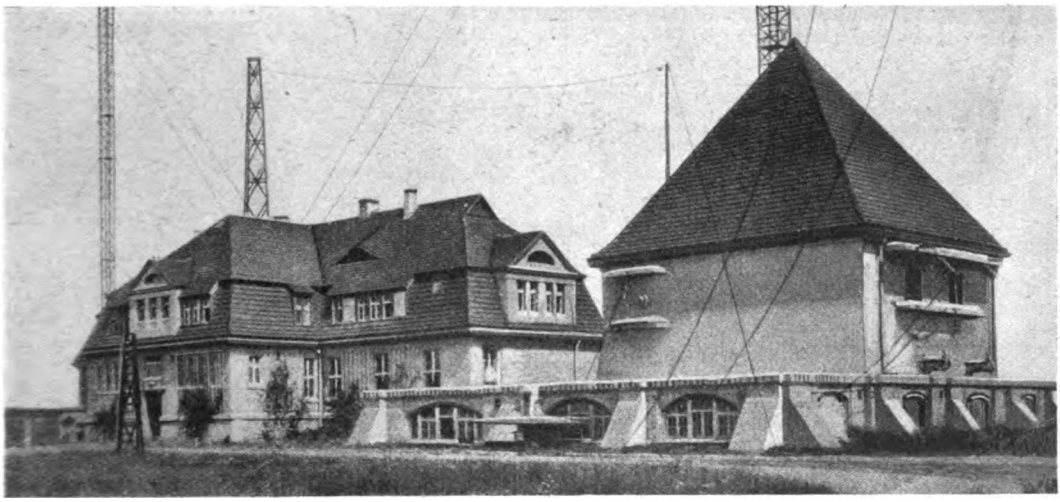

*Fig.* 1. *The Station Buildings.*

Königswusterhausen has the following functions to perform :—

1. Communication between Berlin and the various radio stations in Germany.
2. Broadcasting of weather and financial reports at fixed times.
3. Communication with England, Italy, Norway, Hungary, etc.

To carry out this programme it is essential to operate a number of transmitters at the same time, of which, for example, one works to Breslau, another to Hanover, a third to Frankfort, and so on. The difficulties of this novel problem were solved in a relatively short time and Königswusterhausen has become the most highly developed station of its kind in the world; it has been working for months in the projected manner, and is being systematically further developed. Fig. 1 shows the buildings and Fig. 2 a model of the ten small T aerials for the interior and three large aerials for the European communications. These aerials are carried by five steel masts of 150 metres and one of 100 metres high.

They are arranged to affect each other as little as

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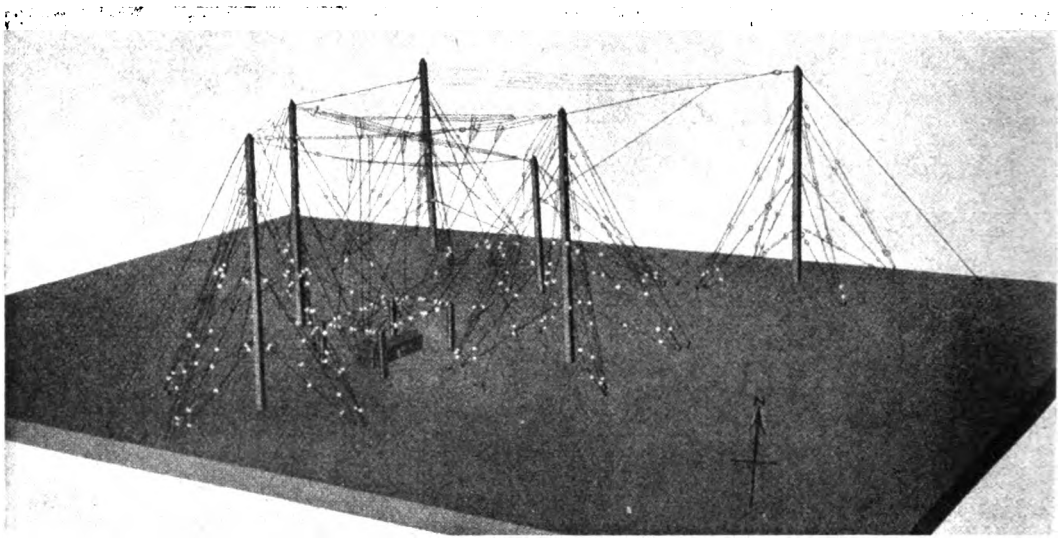

*Fig. 2. Model of the Aerial System showing the arrangement of a number of separate aerials.*

possible, so that transmission on one does not affect any other. To minimise variations of capacity due to the aerials swinging about in the wind, the leading down wires are fastened to wire ropes carried between four wooden masts 30 metres high. Any aerial can be taken down independently of the others.

The transmitters are not connected directly to

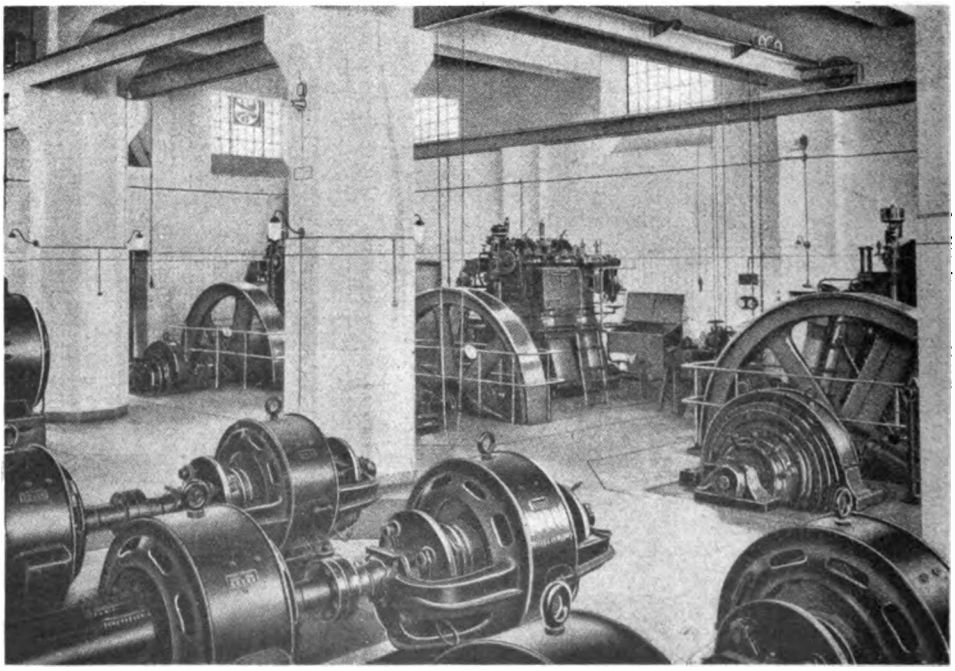

*Fig. 3. View in the Engine Room.*

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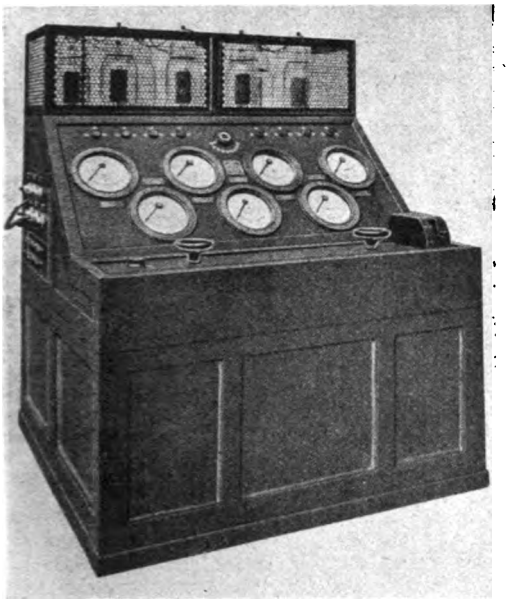

*Fig. 4. A 5 to 10 kW transmitting unit*

*Fig. 5. Rear view of transmitting unit.*

the aerials but through intermediate tuned circuits to avoid harmonics which would interfere with the duplex reception at Zehlendorf.

The following conditions were imposed on the transmitters :—

1. Wavelength continuously variable from 2,000 to 5,000 metres for the small, and to 8,000 metres for the large sets.
2. The greatest possible constancy of wavelength, and
3. Keying the smallest possible power.

The first condition was essential in view of the impossibility of knowing beforehand what wavelength any set would be called upon to use.

The constancy of wavelength is a condition for highly selective reception and for independent working on two waves of slightly different length, which is necessary in view of the large number of waves to be simultaneously employed. The third condition was imperative, seeing that the keying had to be done by relays over lines from the main telegraph office in Berlin.

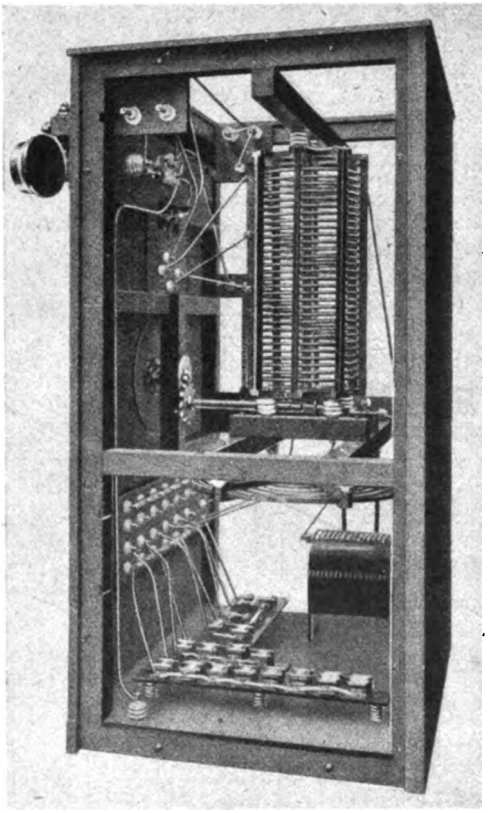

*Fig. 6. A Wave Change Panel of the 5 to 10 kW transmitter.*

The only system to meet these conditions is the three-electrode thermionic transmitter. and the smaller aerials were therefore fitted with Telefunken 0·5—1 kW valve transmitter sets, in which the keying is done by opening and closing the grid lead which carries only one per cent. of the antenna power. The anodes are supplied with D.C. at 3,000 volts, obtained either directly from a high voltage dynamo or by rectification of 500 cycle alternating current. For the small transmitters the former is preferable as being the more economical. In either case the machines are driven by 220 volt

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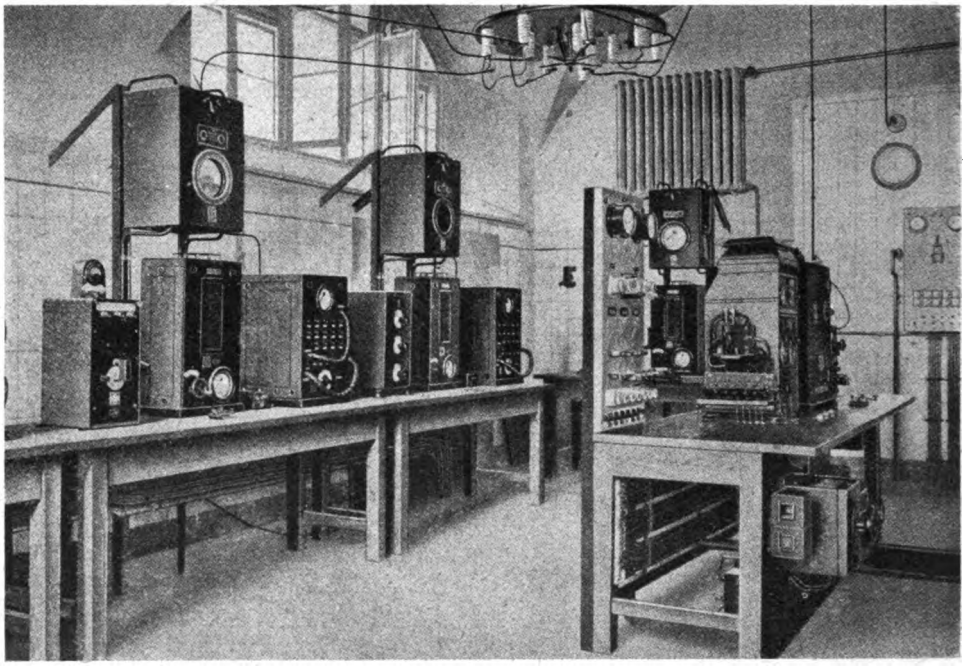

*Fig. 7. The 0·5 to 1 kW transmitting sets.*

D.C. motors supplied from generators driven by Diesel engines. Fig. 3 is a view in the engine-room, and Figs. 7 and 8 show the room containing the small transmitting sets. In addition to these ten sets there are two large sets supplying 5 to 10 kW to the aerial. One of these sets has been in operation for over six months. It gives 10 kW to the aerial if directly coupled and 5 kW when used with

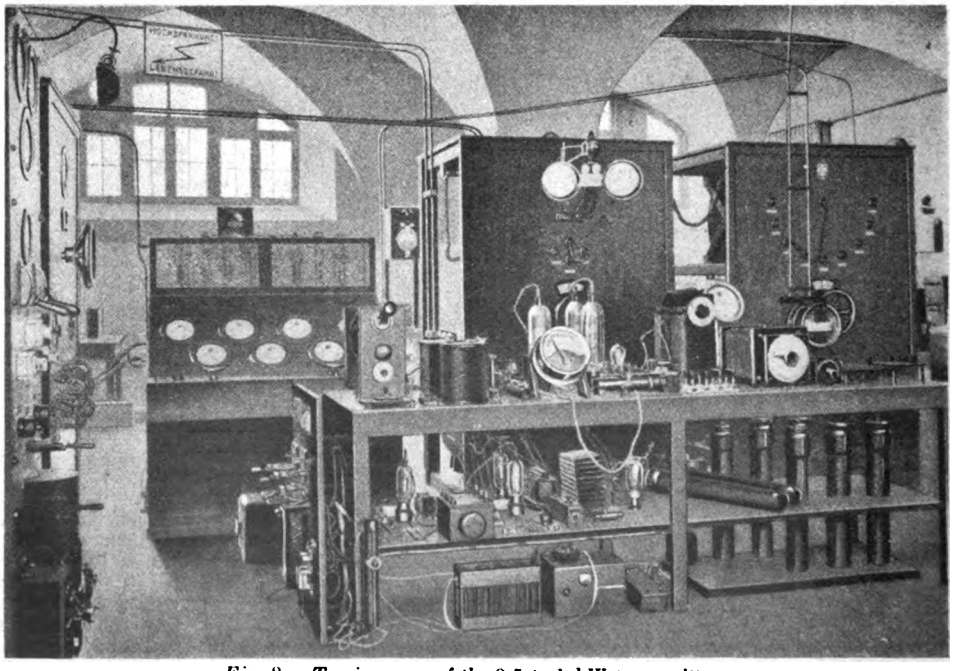

*Fig. 8. Tuning gear of the 0·5 to 1 kW transmitters.*

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an intermediate circuit, that is, as usually employed. In order to get as much data as possible it was arranged so that it could be connected up in many different ways to work with self or separate excitation, with or without an intermediate circuit, and therefore with 5 or 10 kW in the antenna. Over the continuously variable range of wavelength from 2,000 to 8,000 metres, it gives results with separate excitation superior as regards constancy to those obtained with any other system. The separate excitation consists in the use of a generator of only 0·5 to 1 kW to set up high frequency current in a closed circuit from which power is supplied to the grid circuit of the large valve which merely acts as an amplifier supplying power to the antenna. The frequency is thus not affected by any changes in the antenna, and this system has the added advantage that the keying can be done in the grid circuit of the small valve. Some details of the components of one of these sets may be seen from Figs. 4, 5 and 6.

employs for this purpose has given good results. Communication has been obtained over 3,600 km with such clearness that the voice of the speaker could be identified. In this system the voice modulates the D.C. supply to the valve; in the 5—10 kW transmitter with separate excitation, the modulation operates on the D.C. supply to the 0·5—1 kW exciting valve. A 3-electrode valve is inserted in the D.C. supply circuit (filament-anode), and the grid potential is controlled by the voice, thus causing a large variation in the resistance thus inserted in the D.C. circuit.

The advantages of this sytem, in which the actua. telephonic apparatus has no connection with the high-frequency apparatus, but only with the D.C. supply of the small exciting valve, are obvious. In the tests in which a range of 3,600 km was obtained, the transmitter was working on reduced power, the antenna power being modulated between 0 and 8 kW.

The source of power for the 5—10 kW set is a

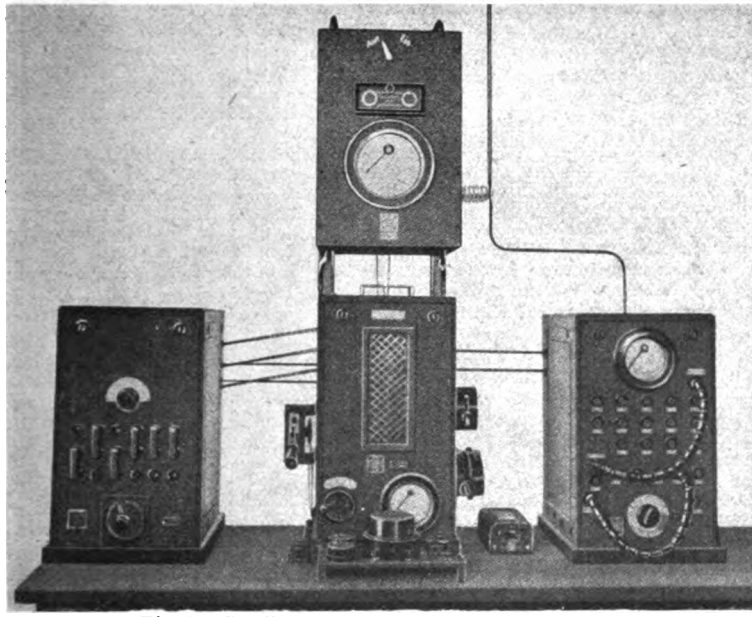

*Fig. 9. Small transmitter set with intermediate unit.*

Fig. 9 is a view of one of the small transmitter sets with intermediate circuit.

A large and a small Poulsen arc of an earlier date are still in working order, and are also used for the foreign traffic; the 80 kW spark transmitter has been removed.

The radiated energy can be controlled by a microphone and the voice, instead of by the Morse key. The broadcast service for which private persons may subscribe (about 1,000 receivers were installed by the end of last year) will consist both of telegraphic and telephonic communications. For this purpose the 5—10 kW valve transmitter has been fitted for wireless telephony. The most difficult problem in this connection was the modulation of the power between 0 and 10 kW. The Schäffer system which the Telefunken Company

500 cycle 200 volt alternator, with a 4,000 volt mercury rectifier equipment.

The former station of the German army has thus, since its transfer to the Post Office, undergone a number of modifications which not only make it suitable for new applications, but which also make it a mirror of the progress in that the 80 kW musical spark has been replaced by a great number of modern valve transmitters. The station is a proof that wireless telegraphy and telephony are able very effectively to assist and perfect the part played by wire telegraphy and telephony in the life of the nation.

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Abstracted from *Telefunken Zeitung, pp.* 23–32, Sept. 1921.

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# The Modern View of Electricity and the Three-Electrode Valve*

By G. G. BLAKE, A.M.I.E.E., A.Inst.P.

MY lecture this evening is intended primarily for the more amateur members of this audience. We have had many excellent lectures and discussions on the various applications of the three-electrode thermionic valve; but so far as my memory serves me, it has always been taken for granted that we are all of us familiar with its functions, and the laws which govern its action.

I therefore thought that a brief outline of its mode of action, illustrated as far as possible by experiments, might be helpful to those who have been using ready-made sets, or have constructed their own apparatus from well-known diagrams, without knowing how their sets function.

I will ask you to picture to yourselves throughout this lecture that we live in the midst of an infinite ocean of ether which pervades all things. Matter, as you know, is made up of groups of atoms known as molecules, each atom, according to present theory, consisting of a positive nucleus, around which are arranged a number of electrons (negatively charged).

We can compare each atom to a tiny solar system; between the positive nucleus and its electrons there are relatively vast spaces, which, like the interplanetary spaces of our universe, are permeated by the ocean of ether. In a fragment of any elementary substance, it is believed that there are millions of atoms of that particular element, each made up of a definite number of electrons grouped round a positive nucleus, like planets around a sun, the forces of the whole system being in a state of equilibrium.

It is the definite number and grouping of the electrons which gives to the substance the properties by which we can distinguish it from other elements. In addition to the electrons in each atom, there are vast numbers of free (or unattached) electrons in the interatomic spaces, which, on the application of a suitable electro-motive force, can be caused to move like a swarm of gnats in a summer breeze. This movement of electrons constitutes an electric current.

*Charged Bodies.*

In Fig. 1 is shown the effect of a charged body upon an electroscope. On the left-hand side of the diagram you will see a drawing of the electroscope before you on the lecture table. The rest of the slide shows a number of diagrammatic sketches to illustrate the effect of a charged body upon the free electrons ever present in the metal of the electroscope (which are represented by dots).

(1) The first diagram (on the top left-hand corner) gives an idea of the grouping of the free electrons when the electrical forces in the metal parts of the electroscope C are in a state of equilibrium, in which state no condition of charge is exhibited.

(2) If a negatively electrified ebonite rod R *i.e.*, a rod which has been rubbed with wool and has thereby acquired an excess of electrons, is brought near to the electroscope C, the other strains set up by the excess of electrons on the rod, reach into the interatomic spaces in the

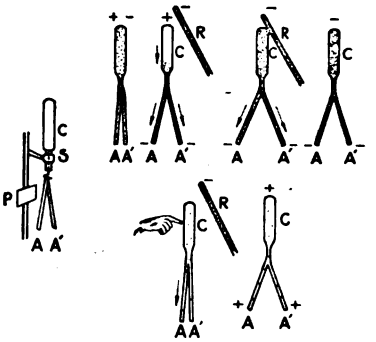


*Fig.* 1.

metal of the electroscope and repel the free electrons there, into the leaves of the electroscope so that they acquire an excess of electrons and repel one another, thus exhibiting a state of charge. If rod R is removed the electrons flow back into their original positions and again the electroscope shows no charge.

(3) If the electroscope C is touched with the charged rod R (see 3rd diagram) the excess of electrons from rod R pass into the electroscope, and when the rod is removed (diagram 4) the electroscope remains in a state of negative charge.

(4) If while a negatively charged rod is held near to the electroscope, we touch the latter (see diagram 5), the free electrons being repelled by rod R, find a path to earth, so that when both my hand and the rod are removed, the electroscope is left with less than its proper number of free electrons, and exhibits a positive state of charge.

(An experiment was shown to demonstrate the effects illustrated in Fig. 1.)

If a piece of any substance is given an excess of electrons, the ether in its neighbourhood becomes strained, and will affect other substances in its vicinity.

If a piece of any substance be robbed of some of its electrons, it is said to be positively charged, and again strains are set up by it in the surrounding ether.

A charged body attracts other bodies in its neighbourhood because the electric strain set up by it in the ether extends into the ether in neighbouring bodies, disturbing the normal distribution of electrons in them. The ether strain then tends to make the charged and neutral bodies move together

* Paper read before the Wireless Society of London on Wednesday, March 22nd, 1922.

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in order that the strain may disappear, in a similar way that when a strain is put upon one end of an elastic thread, having a small weight attached to its other end, the weight moves towards the source of the strain, and so removes the tension.

A body with an excess of electrons (−) attracts a body with a deficiency of electrons (+), and *vice versa*, while two bodies of like sign repel one another.

Charges or currents are not only carried between the atoms by the drift of free electrons; it is believed that as the free electrons move along, some of them collide with the atoms, knock off electrons and take their places; so that a constant interchange is taking place along the length of a conductor, during the passage of a current.

In the case of a liquid or a gas, charges may be carried by ions. Ions are broken fragments of atoms and molecules. Picture to yourselves for one moment a perfect atom, held together by equal and opposite positive and negative forces, which act so as to neutralise one another, so that externally it exhibits no sign of electrical charge; if this atom collides with great violence with another atom, both may become broken, and some of the electrons may be knocked off the one, so that it remains deficient in electrons and exhibits a positive charge, while the other may have acquired an extra number of electrons and show a negative charge.

There are always great numbers of such ions present in all gases and liquids, due to many causes, some of which I will endeavour to explain. Possibly the greatest known source of ionisation (or splitting up of atoms) is the radio-activity of radium.

I have in my hand a small applicator, containing 5 milligrams of radium bromide. This radium, as you know, is gradually disintegrating, and in the process, is shooting off millions of Alpha and Beta particles into the air, carrying respectively, positive and negative charges. The Alpha or positive particles have about twice the mass of a hydrogen atom, and travel at about 1/10th the speed of light, and can only be deflected from their course very slightly by the application of a magnetic field, as was shown by Rutherford in 1903.

The Beta particles carry a negative charge, travel at about 9/10ths the speed of light, and have a mass of about 1/1000th of a hydrogen atom. They are, in fact, electrons; but they are emitted at an enormously greater speed than the electrons in a vacuum tube, and are much more easily deflected in a magnetic or electric field than are the Alpha particles.

The Gamma rays are really not particles but resemble the X-rays in all respects, and are tiny ether waves.

You can readily therefore picture to yourselves the havoc which is taking place in the molecules of air, anywhere within reach of a sample of radium; they are being bombarded by Alpha particles, comparatively so large that it is like throwing brickbats at eggs, and also by the Beta particles.

Then, again, the Gamma waves cause the molecules in the air to vibrate with great violence until they strike against one another and ions are formed.

Certain wavelengths cause maximum commotion amongst the molecules of the air, and therefore maximum ionisation. I may be able to make this more clear to you by an analogy:

Think for a moment of a number of corks floating on the surface of a pool. The corks represent the molecules or atoms, and the water represents the ether. If we create very large wave motion in the pool, the corks will ride up and down gracefully, and all together as the waves pass them, and they will not collide with one another; but if we create very small waves comparable in magnitude to the size of the corks, there will be a general mix-up, and they will all strike against each other.

(An experiment was then shown to demonstrate the ionisation of air by radium and the discharge of an electroscope.)

The explanation of the discharge of the negatively charged electroscope was that its negative charge set up strains in the surrounding ether which repelled the negative ions in its vicinity, and attracted as many positive ions as were required to neutralise it and bring it once more to a state of equilibrium. We have here two spirals of wire coated with radium, kindly lent me by Mr. Harrison Glew, who showed this experiment before the Physical Society this year (this experiment was first shown by Mr. Glew, I believe). One spiral is fastened above an electroscope, and the other, which is some yards distant, is attached to the negative pole of a small influence machine; or it could be connected to the negative terminal of a small induction coil as shown in Fig. 2.

The radium is hard at work ionising the air around the machine and the electroscope; so that there are crowds of negative and positive ions all mixed up somewhat as indicated by the plus and minus signs on the slide.

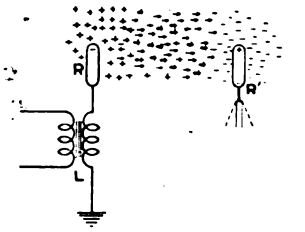


*Fig.* 2.

If we now charge the pole of the machine negatively (*i.e.*, give to it an excess of electrons) it at once begins to repel the negative ions in its vicinity, and to attract a sufficient number of positive ions to neutralise its charge; so that the ions in the air are sorted out and a negative cloud forms in the neighbourhood of the electroscope which expels the electrons from the metal conductor of the electroscope into its leaves causing them to diverge in exactly the same way as did the negatively charged rod which I showed you just now.

(An experiment was then performed to demonstrate the effect just described, which was also illustrated by means of a mechanical lantern slide to show the migration of the ions in opposite directions.)

This experiment could be repeated with the charge on the machine reversed, in which case the electroscope would show a positive instead of a negative charge, the negative ions being attracted by the machine and the positive repelled.

It might interest you to see an experiment

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illustrating ionization by means of ultra-violet rays. In this case the ionization is due to wave motion in the ether, causing the molecules of the air to collide.

(An experiment was arranged to show ionization by ultra-violet rays, using a spark gap fed from a small induction coil. Incidentally, fluorescence of butter, candle, Willemite, X-ray screen, etc., was also shown. A flame will also set up vibration in surrounding atmosphere and cause ionization.)

The molecules in liquids and gases are, when at any temperature above absolute zero, all in a state of motion, moving about amongst themselves. When we say that a liquid evaporates, we mean that some of its molecules move to the surface with such a velocity that they escape into the air, and become dispersed into it. As the temperature of the liquid is increased, there is an increase in the rate of evaporation (or the greater will be the number of molecules emitted).

Evaporation of electrons from the surface of a substance takes place in a very similar manner.

We have now reached a point when we should be able to more easily comprehend what happens inside a three-electrode valve when in use. Fig. 3 shows the form of some typical three-electrode valves.

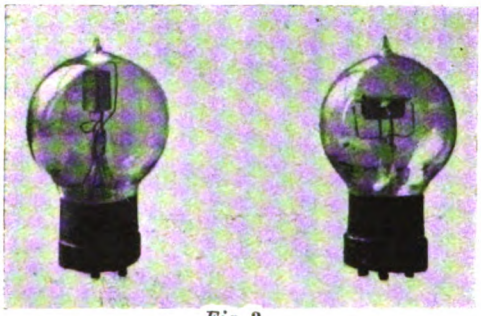

*Fig.* 3.

As you know, the "hard" valve is exhausted so greatly that we can for practical purposes consider it as a still silent pool in the ocean of ether. Although it is, of course, impossible to remove all molecules of gas from its bulb, so few remain that their presence can be neglected.

We now heat the filament, by the passage of a current, and as its heat increases it emits an increasing number of electrons. These will rapidly create a negative electric field (which we call the space charge) round the filament, which will repel further negative charges and so tend to stop further emission of electrons from the filament. If, however, we now supply a sufficient positive charge to the plate of the valve, the electrons in the "space charge" will be attracted along the strain lines which exist in the ether between the plate and the filament, making room for others from the filament, so that a negative flow of electrons or current passss from filament to plate. The high tension battery connected between filament and plate acts like a pump, and carries away the electrons from the plate, keeping its potential positive and passing the electrons along to the filament and so keeping its potential negative so that we have a perfectly continuous flow of electrons.

Now let us once more return to our analogy of water evaporation. Consider the surface of the water to represent our heated filament, and the heat of the atmosphere to represent the positive high tension on the plate.

If we raise the temperature of the atmosphere and keep it steady, it will take up more and more molecules of water until a point is reached when it can no longer take up any more, and as many molecules are condensed back into the water as are emitted from it. The atmosphere is now said to be saturated.

A similar phenomenon is observed in the operation of a valve. For any given positive potential applied to the plate of a valve, as the heat of its filament is increased, a point is at last reached where the valve is so charged with electrons that they constitute a negative field strong enough to repel the new electrons coming from the filament, and therefore stop all further increase, the excess of electrons being returned to the filament.

This is called saturation point.

If we raise the plate voltage we shall have to increase our filament temperature, in order to reach saturation point. In other words, if we make the plate more positive, we shall have to supply a larger number of electrons to balance the forces in the tube.

Let us now consider the functions of the grid.

The grid, which is placed in the electron stream, between the plate and filament of a three-electrode valve, is employed to control the electron flow in several ways. In order to study its action, let us examine a circuit connected up as in Fig. 4a, where P is a potentiometer. When connected as shown, the grid is at zero potential. If the slider S is raised, the grid will become negative to the filament, and if lowered, positive.

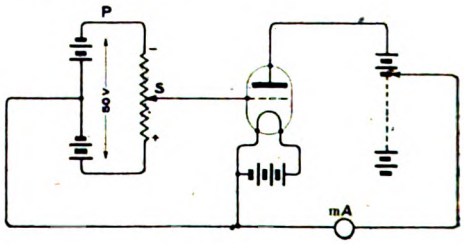


*Fig.* 4a.

Let us imagine that an electron stream is passing from the filament to the plate (below saturation point); so long as the grid is kept at the same potential as the filament, the electron flow will go to the plate as usual. If, however, we give the grid a positive potential, we shall assist the flow of the electrons to the plate, and a portion of them will pass into the grid circuit constituting a grid current. If we make the grid negative, it will repel electrons, which will accumulate in the space between the grid and filament, forming a space charge, or negative field, which will, if the grid be made sufficiently negative, entirely cut off the electron flow to the plate. By suitable arrangement of filament heat and plate potential, matters can be so arranged that very small changes of grid potential will produce large variations of plate current. The valve then acts as a delicate relay, and has a great

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advantage over all mechanical relays in that it exhibits no lag effects.

In Fig. 4b, you will see a series of curves. During the making of these the filament temperature was kept constant, and seven curves were plotted for different values of plate voltage.

You will observe :—

(1) That increasing the plate voltage lengthens out the straight portion of the curve.

(2) Also, if our valve functions at a point near the centre of, say, 33·5 volt curve, and we wish it to function at the same point, on a higher plate voltage, it will be necessary to make the grid more negative, the reason being that with the higher plate voltage the space charge is reduced, therefore the grid needs to be made more negative to take its place.

There is another very useful piece of information which we can obtain from a study of these curves, *i.e.*, the amount of amplification of which the valve is capable. You will observe that if we keep our grid at zero potential, an increase of plate voltage of 20·5 negative gives us a rise of about 7 M.A. in the plate current. We could obtain this same rise of plate current, without any increase of plate potential, by making the grid 3 volts positive; therefore, if we divide the 20·5 by 3, we find that we are obtaining an amplification of 6·83· by use of its grid.

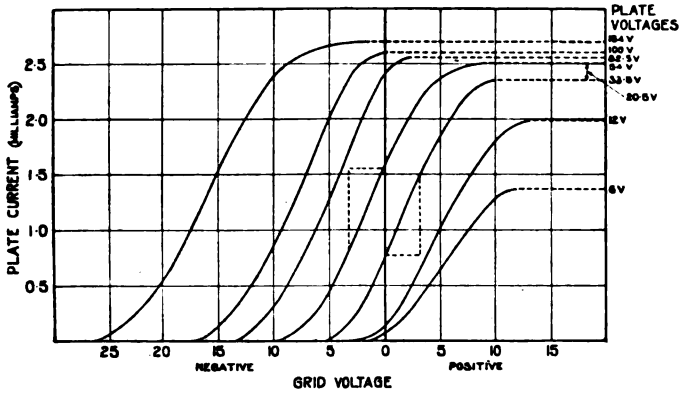
As Fig. 4b shows, by making the grid 3 volts negative we shall obtain a similar decrease in plate current.

(An experiment was performed illustrative of the voltage amplification of the valve, and of the grid current characteristic. The experiment showed that the same increase of plate current could be obtained, by adding 6 volts to the plate current, as by keeping the plate current constant and making the grid 1 volt positive, showing for this particular valve an amplification of 6.

Fig. 5 illustrates the effect on the characteristic curve of the valve if we vary the filament current.

If we plot a series of curves with a fixed plate voltage, showing grid potential against filament current, we shall see that the increase of filament temperatures gives great increase of plate current, and that if we wish our valve to function, at the same point, on a higher filament current curve, we must make the grid more positive.

The reason for the above becomes more clear, if we remember the negative space charge between the filament and the plate, and that when the plate voltage is increased, it becomes more rarefied, so that a negative charge will be required on the grid to take its place, and that when the filament current is increased it becomes denser, so that a positive voltage will be required on the grid to reduce it.




*Filament current* ·6 *amp.* $\frac{20\cdot5 \text{ volts plate}}{3 \text{ volts grid}} = 6\cdot833$ *amplification.*

*Fig.* 4b.

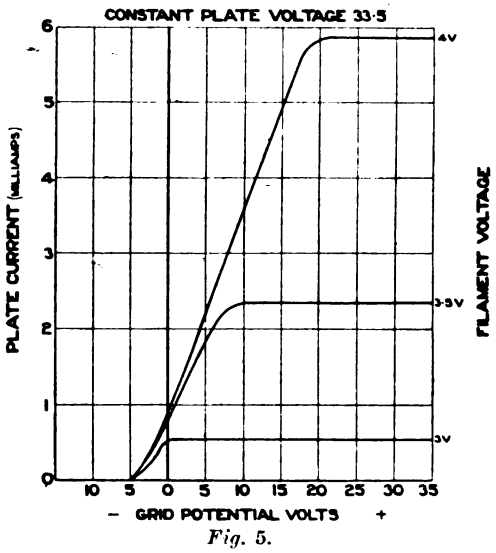



*Fig.* 5.

Stanley has shown that if a galvanometer in the grid circuit shows that a reversed grid current is flowing when the grid is made increasingly negative, that this reversed current must be due to ions in the valve, and that the vacuum is therefore soft. This is a ready method of testing the vacuum of a valve. *(To be continued.)*

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# Discussion on Methods of Amplification

(*Concluded from page* 42.)

**Mr. G. P. Mair.**

Mr. Phillips has given us a very interesting diagram of connections, and there are one or two questions I should like to ask him. I have been working a three-valve set made up much on these lines, but I do not use a condenser to tune the secondary of the high-frequency transformer, and I get good results. I have not tried Mr. Phillips' arrangement of the detector circuit, but I rather agree with him as to the theory and action. In connection with the set I, personally, connect the negative of the high tension to the negative of the low tension and earth the low tension positive. I get much better results on spark stations and telephony like this than if I earth the negative of the low tension. Personally, I have not been able to explain why it is although I have tried. Another point in connection with the circuit is the question of making the grid of the low frequency valve negative, I have tried it at times and got pretty good results by putting a resistance (somewhere about 1 ohm to 1½ ohms) in the filament lead, to which the grid side of the transformer is connected. By putting in the filament circuit of a low frequency amplifier, a resistance of about 1 to 1½ ohms, and having a variable resistance in the other lead, varying the filament rheostat and this other resistance, enables me to get the maximum intensity of signals. Personally, I am using V.24 valves, and I have also used the same arrangements with the ordinary R type of valve, but with the V.24 I have always thought it necessary to put in a small resistance in the manner described.

**Mr. C. F. Phillips.**

Referring to Fig. 7 (*see* p. 40), it will be seen that the grid is about 2 volts more negative than the most negative end of the filament. In Mr. Mair's arrangement I understand that he puts a fixed resistance between the bottom of the grid coil of the transformer and the negative of the L.T. battery; he would, of course, reduce the value of filament resistance shown in Fig. 7; the result is to bring the grid back to about zero volts and that is evidently the particular potential required by the V.24.

With regard to Mr. Mair's other point; provided that the insulation of the H.T. battery to earth is good, I do not think that it matters, as regards signals, to which end of the L.T. battery it is connected. If the H.T. negative is connected to the L.T. negative, the effective potential between plate and filament is less than when the H.T. negative is connected to L.T. positive. That is the only effect I can think of.

**Mr. C. S. Dunham.**

I should like to ask Mr. Phillips a few questions. The first is that I cannot agree with Mr. Phillips as regards the non-amplification of the high frequency transformer. I have done a good deal of work with high frequency transformers, and I have found that the amplification is quite good, very good in fact. Regarding Mr. Phillips' method, which, I imagine, commercially goes under the name of reactance capacity coupling, I do agree that the coupling condenser more or less takes the place of the capacity that you get between the primary and secondary winding of your intervalve transformer, but at the same time I think that the two windings of the transformer can be kept a reasonable distance apart and the capacity reduced in that manner.

Some time ago our past President, Mr. Campbell Swinton, gave us a lecture in which he demonstrated very well the effect of high frequency transformers. He wound his transformers with the secondary wound over the primary. Of course, that gives good coupling, but, at the same time, if one takes into consideration the length and mean diameter of the primary coil and the secondary coil that is going to vary, and therefore the number of turns on the transformer may be the same, but the inductance has a tendency to alter. I, myself, prefer the transformer with the secondary coils placed side by side for one can then know the exact amount of wire on the secondary and primary. Regarding Mr. Phillips' method of plugging in coils to obtain difference of the anode inductance values, that seems to me quite a good method, but I do not like the idea of using the multilayer coil for short waves. It seems to me that the multilayer coil is a device for getting a large inductance in a small space, and the degree of coupling, it seems to me, must be less efficient than if one uses the pancake coil where the surface area is much greater, the coupling consequently much better. That is all I can say with regard to low frequency.

I notice that in Mr. Phillips' design he does not earth the iron of the transformer, which is supposed to get rid of a lot of noise, due generally I consider, to eddy currents that circulate in the iron. A thing which seems to me rather foolish is that if one earths the iron by connecting together with a strip of copper or whatever material you may choose, one gets rid incidentally of the insulation that exists between the transformer core laminations, and, therefore, although you have a path to earth of eddy currents it seems to me that the tendency of that circulation of eddy currents is increased because the core becomes one solid block of iron without any insulation between the laminations. Doubtless I am wrong, but perhaps Mr. Phillips will put me right on a few of these points.

**Mr. C. F. Phillips.**

First of all I think Mr. Dunham must have misunderstood my remarks about high-frequency transformers. I did not suggest that they did not *amplify*, I said that they did not *transform*. I quite agree that they do amplify, but I maintain that the method of using two coils instead of one is rather unnecessary in most instances.

You spoke of multilayer coils not being suitable for short waves. With regard to the advantages of multilayer coils, the first is that they have an appreciable distributed capacity, and also a some-

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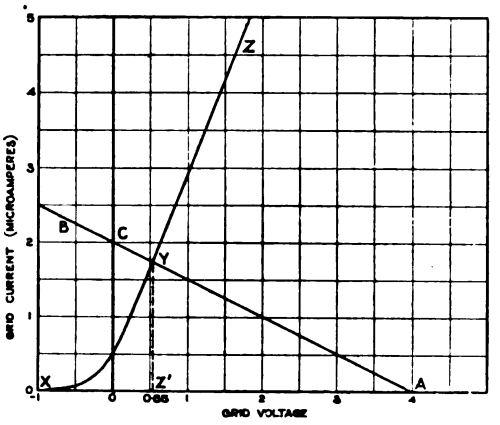
what large high-frequency resistance. Leaving out the high-frequency resistance for the moment, it may be of interest to note that one needs a considerable capacity across any coil used in my circuit as a rejector of *short* waves. If you do not have enough capacity, preferably distributed and not external to the coil, you get such very sharp resonance points that the actual working of the circuit becomes very difficult; as the various coils of the receiving circuit are brought into resonance one is apt to get nothing but a series of clicks when the resonance curve of the reactance coil is too sharp. It is interesting to make the experiment in a practical way; first, try the single layer coil and then a multilayer coil, you will soon be convinced that a certain amount of capacity is necessary.

Incidentally, there is no question of coupling; the reactance coil should not couple to anything, and it is quite hard to prevent such stray coupling. The coil should be placed well away from the tuning circuits, as if stray coupling does take place you never know which way round it is going to act; if there should be any reverse coupling you will be in trouble on short waves! The coil I have shown there in the rejector circuit is not a coupling of any description, the coupling is the capacity, and the rejector circuit is merely a circuit which permits of the very maximum of potential being built up from one end to the other—that is to say, the combination of coil and condenser becomes an infinitely high resistance for currents of the frequency of the wavelength you are trying to receive and therefore potentials from one end to the other are at a maximum.

As regards the earthing of the cores of low-frequency transformers. This certainly does get rid of a lot of noise in some cases, but I do not attribute such noise to eddy currents; it is rather due to leakage of H.T. and possibly to the accumulation of a charge on the core. As a general rule, I usually earth a single transformer unless so doing causes any noise, but when using two or three transformers in the same amplifier, I find that earthing the frames is sometimes enough to cause a certain amount of coupling between them, and thus render the generation of low-frequency oscillations probable. I do not think that a metallic connection to the core would have the slightest effect on eddy currents.

### Mr. P. R. Coursey.

I think we ought to thank Mr. Phillips for his excellent account of a means of simplifying the problems of high frequency amplification. There is one little point that I should like to make with regard to his remarks about the grid leak of a detector valve. I certainly agree with him that connecting the leak either to the positive or to the negative of the valve filament will not make much difference to the grid potential, but it may also be of interest to show how one can find what actual the potential is. If one can plot out the grid characteristic of the valve, *i.e.*, the grid current against the grid volts, it may be somewhat as shown at XYZ in the accompanying figure. Well, now, if the total difference of potential that can be impressed on the grid leak is, say, 4 volts, we should mark off 4 volts on the axis of grid voltage as at A, and set out a straight line AB to represent the resistance line of the grid.




That is to say, the slope of this line should equal the resistance of the grid leak. For example, suppose, as described by Mr. Phillips, the grid leak resistance = 2 megohms, and the potential difference across the filament = 4 volts, we should set off OA = 4 volts and OC = the current passed by 2 megohms on 4 volts—

$$= 4/2 \times 10^6$$

= 2 microamperes.

This straight line will intersect the grid characteristic at some point such as Y, then the potential which the grid will assume will be given by the distance OZ′ measured along the axis of grid voltage.

### Mr. C. F. Phillips.

I think that is a pretty way of getting at grid potential but he is not telling you how to get that curve. The only difficulty is that I cannot personally plot out the grid characteristic owing to the lack of sufficiently sensitive instruments.

### Mr. P. R. Coursey.

If Mr. Phillips does not mind my criticising his remarks, there is one point which I would rather like to mention. He referred to the "resistance" of the condensers for various frequencies, and in giving these resistances he mentioned such figures as 15,000 ohms. I should be sorry to have to use a condenser having that resistance. I take it that he really meant "impedance."

I think there is one other little point raised by another speaker about the self-capacity of multi-layer coils when using them for coupling the H.F. valve to the detector. I do not think it is perhaps realised as generally as it should be that the increase of high frequency resistance due to the self-capacity of the coil is due to the current which flows through the capacity. If we have a coy and connect a condenser across it, the self-capacitil and the coil is added to the external capacity, so that for the frequency to which the circuit is tuned if the coil has inductance $L$ and with total capacity $C$ its effective resistance is given by $L/CR$ where $R$ is the true high frequency resistance of the coil itself. Hence, for this purpose, it does not matter much where the capacity is located, *i.e.*, whether it is in the coil itself or outside. In any

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case also the plate capacity of the valve is added also on to the total effective capacity.

**Mr. M. Child.**

There are one or two little points which I would like to ask Mr. Phillips about. I notice, first of all, that there has been a slight discussion between the merits of the transformer coupling and the reactance capacity method, which Mr. Phillips advocated. I do not think that the latter circuit shows very much advantage over the transformers if these are of values properly chosen. I quite agree with Mr. Phillips that there is self-capacity between the primary and secondary high frequency transformer, and as a rule that capacity may be transmitted from the plate circuit to the grid circuit of the next valve, but I am not quite sure whether we are justified in assuming that that is all the transformer does. In his diagram (Fig. 1), Mr. Phillips shows a grid leak of 2 MΩ. That grid leak is for keeping the grid of the valve at a constant potential until the signals arrive Now, if we take the next diagram (Fig. 2) shcwing the transformer coupling, we dispense with the grid leak, and we substitute a winding of a relatively low resistance but of a high impedance. Mr. Phillips, will you kindly put in a condenser and a grid leak ? I had in my mind that it was possible to use a valve, what we might call a special detecting valve in that second position where it is not necessary to control the grid with condenser and grid leak, and in that case we may use, if necessary, a potentiometer and then the transformer of the secondary comes direct to the grid without the condenser and the leak. Now, what I should like to know definitely (if anybody can tell me), is whether that secondary now is not producing a potential difference between it. Under these conditions would the magnetic field in the primary of the transformer, be electronic ? I think it is. We have more the true transformer than we ordinarily get with the condenser and grid leak in its place. Another little point I noticed was that Mr. Phillips referred to that circuit marked X in Figure 1 as the rejector circuit. I understand that a rejector circuit is not a proper rejector circuit unless the resistance of the inductance is made extremely small. Now this is rather important, more so when you take into consideration that in practice if we want to get a long wavelength the capacity must be large. If those inductances which Mr. Phillips has actually shown us in practice are tuned, I do not think their resistance is by any means small enough for the circuit to be compared to a rejector circuit, but I daresay the advantage is explained in using those coils, and that you do get sharp tuning. If, however, you make the circuit very selective, and keep down the resistance, then the resonance is so difficult to obtain that it is almost impossible to work it in that way. I think it is a good thing to have some resistance. I would like to ask Mr. Phillips whether he always recommends joining the secondary of the low tension transformer to the negative side of the battery. We already have at this point resistance. There are circumstances where I find it very desirable to do so, such as for the reception of ordinary Morse signals, but I do not find it always an advantage to do that when one requires to receive telephony ; it depends to a certain extent on the type of valve used, and its characteristic curve. I think Mr. Phillips will agree with me that that little point ought to be followed up. One ought to have a switch to switch that connection on to different places when one is receiving spark or telephony. I think we all ought to thank Mr. Phillips for opening this interesting discussion ; the making of the low frequency grid positive is a very good scheme, and will assist a great many of us to keep our circuits steady on short-wave work.

**Mr. C. F. Phillips.**

I quite agree that transformer coupling has one advantage over reactance capacity, and that is the ability to use a potentiometer. Some people find it difficult to secure efficient rectification by potentiometer control of the grid, and I do not think that the average valve on the market gives such good rectification by potentiometer control as it does by grid current control as exercised by a grid condenser. In certain circuits the use of a grid condenser is absolutely barred : I allude to circuits used in front of high speed printing apparatus. A grid condenser may lead to temporary paralysis of the grid by an atmospheric, and before the grid has discharged through the leak, portions of a high speed signal might be missed.

With regard to the true rejector circuit, Mr. Child is quite right ; it has large circulating currents in it, but currents of the frequency to which it is tuned will not pass through it. To ensure its behaviour in complete accord with this theory, it must be of very low resistance, and is consequently usually of low inductance and high capacity.

Touching low frequency amplification, it is certainly as well to be careful not to make the operative point such that the valve is working near the bend of its characteristic curve, as that would cause the low frequency signals to be re-rectified. Such re-rectification would occasion serious distortion of speech or music. In short, one should keep the grid of a L.F. valve as negative as is possible without producing re-rectification.

**Mr. H. H. Burbury.**

There is one question I should like to ask. I have for a long time used transformer coupled high frequency amplification, but I find I rather agree with Mr. Phillips that they do not altogether transform, and this can be shown if anybody will try connecting the filament connection to the secondary when they get signals almost as strong. That appears to me to cut out the theory that they really do transform.

At the same time I think one gets quite as good results from a transformer as you do from Mr. Phillips's circuit in point of magnification.

**Mr. M. Child.**

Might I suggest that if that circuit is possible the valve is one in which you get a very low velocity, you must have the connections controlled to the grid on the grid circuit of your battery to keep the grid normally straight, otherwise a charge accumulates and pops off through the valve.

**Mr. C. F. Phillips.**

Oh no, Mr. Child, it leaks through your faulty high frequency transformer and gets off that way.

**Mr. M. Child.**

That is due to bad insulation.

**The President.**

Gentlemen I think you will join in thanking Mr. Phillips and the other speakers for an interesting

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paper and discussion. As regards the last point, I have had a broken wire in my transformer without the signals stopping and I am inclined to agree with Mr. Phillips in that respect.

All the members for ballot have been duly elected.

I should like to say that if any of you feel inclined to give us lectures we shall be very glad if you will send in your names. We have no particular lecture arranged for next month and volunteers will be very gratefully accepted, not only for our own Society here but for the affiliated societies around London and in the Provinces.

That, I think, closes the Meeting.

**Mr. C. S. Dunham** (*communicated*).

I think Mr. Phillips rather misunderstood me; possibly I did not make my meaning quite clear. Experience seems to show that the tighter the coupling between the primary and secondary windings of a high frequency transformer the better, and it was to this coupling that I referred in my remarks, not to the coupling between anode coil in a reactance-capacity coupled amplifier, and other parts of the circuit. Hence my remarks that one could obtain better coupling on the shorter waves by using a basket coil, in preference to any system of multi-layer winding, which latter gives a comparatively small coupling surface except for wavelengths of say 4,000 metres upwards.

It is true that the basket coil, owing to its low self-capacity would give rather a peaked curve, but as Mr. Phillips suggested the coil could be well soaked in wax. Other methods of reducing such a wave will suggest themselves, such as, for instance, winding part of the transformer coil with resistance wire, coupling the primary and secondary with a small condenser, etc.

These methods were not, however, intended to be used in the reactance capacity coupled amplifier, where there is, of course, no necessity to have a large coil. The smaller the better in fact, so as to be free from the possibility of interlinkage of external fields which might create very undesirable results. The self capacity of this coil forming the damping element, it seems that any multilayer coil forms the ideal system of winding, and the much abused "slab" winding comes into its own.

**Mr. C. F. Phillips** (*reply to Mr. Dunham—communicated*).

I am sorry I misunderstood Mr. Dunham's earlier remarks. I agree that the tighter the coupling between primary and secondary of *commercial* high frequency transformers the better. That seems to prove my contention that they do *not* transform, as the tighter the coupling the higher the capacity between windings and the more nearly do you approach the system of reactance-capacity coupling.

**Mr. P. G. A. H. Voigt** (*communicated*).

I disagree with Mr. Phillips in making the first grid 6 volts positive. If you change your grid voltage from zero to 6 volts positive three things occur.

Firstly you change the point of the characteristic on which you work, but according to the commonly accepted theory, you might effect this change equally well by an increase of about 30 v. of H.T.

Secondly, there is a considerable grid current, which acts in every way as if the insulation of the aerial was bad. According to Mr. Phillips this loss can be replaced by a little more reaction. If this is true, then why do we insulate our aerials very carefully? It is well known that with bad insulation, the results are bad, in spite of any amount of reaction.

Thirdly, you get stability. In order to get stability in my own set I use capacity reaction in a suitable way, and can stabilise the set at any time without that loss of efficiency which is produced by a positive grid voltage.

Mr. Phillips mentioned early in his lecture that it was desirable to use a tuning condenser of extremely low self capacity in the "rejector" or tuned plate circuit. Later he said that the coils used in this circuit should have a high self capacity.

I fail to see why you should go to great expense getting special condensers with a low maximum capacity when you afterwards sometimes dip your coils in wax to bring that capacity up again.

I find that with ordinary wavelengths if the minimum capacity is small the coils become very aperiodic when no condenser is used. For example, one of my coils tunes from 2,000 metres up to 3,000 with a 0·002 condenser, but the minimum is very badly defined, and even 600 metres comes through very well, indeed. If, however, the least additional capacity is put in parallel, the 600 metre signals vanish. With regard to the condenser in parallel with H.T. Once I connected up a new set with a new H.T. and found by careful test that the addition of a large condenser in parallel with the H.T. did not make the least difference. Six months later when the H.T. was much colder I repeated the experiment, and this time it made an immense difference to the high frequency side of the set, but no appreciable difference to the low frequency side. This shows that the impedance of the H.T. is negligible for L.F., and a few hundred ohms more or less will make little difference to the low frequency side. For H.F., however, this is not the case, and the condenser provides a low impedance path for the oscillations.

Lastly, one of the speakers asked "if connecting the transformer stampings together in order to earth them did not produce eddy currents?" The answer is no. The eddy currents cannot flow unless the circuit is complete, and this requires at least two such connections.

**Mr. C. F. Phillips** (*reply to Mr. Voigt—communicated.*)

If Mr. Voigt will examine Figs. 1 and 6 he will see that the grid is about 4, not 6, volts positive. As regards his three points:—

1.—I want to change the point on the characteristic from the bottom bend to some way up, in order to prevent distortion; why bother to increase H.T. voltage to do so?

2 and 3.—With a grid current of 100 microamps. the grid filament resistance of the valve is reduced to 40,000 ohms, not a very serious loss of insulation: the results are *not* bad, and what is lost on insulation is more than made up by perfect control over regeneration, and thus maximum signal strength. The proof is easy; try both methods and judge for yourselves.

Mr. Voigt assumes that external capacity in shunt with an inductance has the same effect as distributed capacity. This is not so, as high distributed capacity flattens out a resonance peak far more than does the same value of external shunt capacity. I do not understand Mr. Voigt's remarks about his coils.

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# Notes on the Design of Radio Frequency Intervalve Amplifier Transformers using Iron Cores

By A. S. Blatterman, B.Sc., E.E.

(*Continued from page* 51.)

**Coefficient of Coupling.**

Let $M$ = mutual inductance between primary and secondary
$L_1$ = self inductance of primary
$L_2$ = self inductance of secondary
$K = \frac{M}{(L_1 L_2)^{1/2}}$ = coefficient of coupling
$\Phi$ = total flux linking both primary and secondary
$\phi$ = leakage flux between primary and secondary
$N_1$ = number of turns on primary
$N_2$ = number of turns on secondary
$I_1$ = primary current
$I_2$ = secondary current

The mutual inductance $M$ is defined as

$$M = \frac{N_2\Phi}{I_1 \times 10^8} = \frac{N_1\Phi}{I_2 \times 10^8}$$

and the self-inductances $L_1$ and $L_2$ as

$$L_1 = \frac{N_1(\Phi + \phi)}{I_1 \times 10^8}$$

$$L_2 = \frac{N_2(\Phi + \phi)}{I_2 \times 10^8}$$

Hence

$$K = \frac{M}{\sqrt{L_1 L_2}} = \frac{\Phi}{\Phi + \phi} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

The leakage flux $\phi$ is calculated with the help of equation (11) and is found to be

$$\phi = \frac{4\pi N_1 I_1}{10} \times \frac{4\pi l}{3} \times \frac{1}{\log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}}} \quad \ldots\ldots\ldots\ldots (13)$$

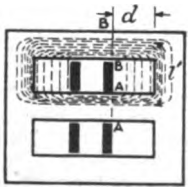


*Fig.* 9.

The mutual flux $\Phi$ may be considered as produced by the primary, passing through the central core leg and returning partly through the end core sections and in part also across the air path between the secondary and these end core sections as shown in Fig. 9.

The reluctance of the composite magnetic path outside the coils from section AA to section BB is, for the air part, approximately

$$\mathfrak{R}_a = \frac{3}{4\pi d} \log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}} + \frac{d}{\mu A}$$

and for the iron

$$\mathfrak{R}_i = \frac{l' + 2d}{\mu A}$$

The ratio of these two is therefore

$$\frac{\mathfrak{R}_i}{\mathfrak{R}_a} = \frac{l' + 2d}{\mu A} \times \frac{1}{\frac{3}{4\pi d} \log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}} + \frac{d}{\mu A}}$$

In many cases this ratio is very small and in such cases the flux $\Phi$ may be taken as that following

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the iron circuit alone. The calculations are thereby simplified considerably. As an example may be taken a transformer core used in a certain line of transformers built at these laboratories in which

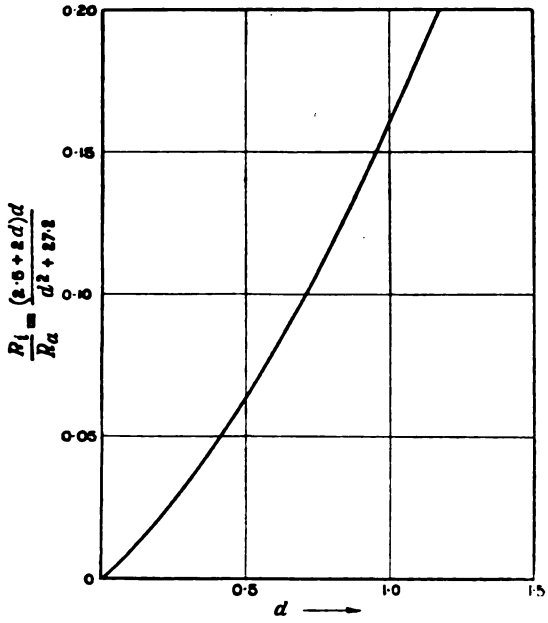


*Fig.* 10.

$A = 0{\cdot}87$ sq. cm

$\frac{b}{R} \doteq 2$

$\mu \doteq 100$

$l' = 2{\cdot}5$ cm

This gives

$$\frac{\mathfrak{R}_l}{\mathfrak{R}_a} = \frac{(2{\cdot}5 + 2d)\,d}{d^2 + 27{\cdot}2}$$

Fig. 10 shows values of this ratio for different values of $d$ and it is there seen that at least 90 per cent. of the flux will follow the iron for values of $d$ up to nearly 1 cm. Therefore, in this case and particularly when it is remembered that the flux paths under consideration form only a part of the entire magnetic circuit, the error is not great if the flux $\Phi$ is calculated on the basis of the iron path alone with length $l$ cm and cross-section $A$ sq. cm. If desired, the air paths may be approximately accounted for by mathematically increasing the iron section $A$ slightly (from about 3 to 8 per cent.).

We have then for the mutual flux $\Phi$

$$\Phi = \frac{4\pi N_1 I_1}{10} \times \frac{1}{\frac{l}{\mu A} + \frac{\delta l}{A}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (14)$$

giving for the coefficient of coupling

$$K = \frac{\Phi}{\Phi + \phi} = \frac{1}{1 + \phi/\Phi} = \frac{1}{1 + a} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (15)$$

where

$$a = \frac{4\pi l}{3} \times \frac{\frac{l}{\mu A} + \frac{\delta l}{A}}{\log \frac{2R}{b + 2R - \sqrt{b^2 + 4bR}}}$$

or letting $\frac{b}{R} = \sigma$

$$a = \frac{4\pi l}{3} \times \frac{\frac{l}{\mu A} + \frac{\delta l}{A}}{\log \frac{2}{2 + \sigma - \sqrt{\sigma^2 + 4\sigma}}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

**Primary and Secondary Inductances.**

The primary inductance is

$$L_1 = \frac{(\Phi + \phi)\,N_1}{I_1 \times 10^8}$$

$$= \frac{4\pi N_1^2 I_1}{I_1 \times 10^9} \left( \frac{1}{\frac{l}{\mu A} + \frac{\delta l}{A}} + \frac{4\pi l}{3 \log \frac{2}{2 + \sigma - \sqrt{\sigma^2 + 4\sigma}}} \right)$$

$$= \frac{4\pi N_1^2}{10^9} \left( \frac{1}{\frac{l}{\mu A} + \frac{\delta l}{A}} \right) \left( 1 + a \right) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

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The secondary inductance is similarly

$$L_2 = \frac{4\pi N_2^2}{10^9} \cdot \left(\frac{1}{\frac{l}{\mu A} + \frac{\delta l}{A}}\right) \cdot \left(1 + a\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

It is to be noted that these inductances both comprise a portion due to leakage flux $\phi$ and calculable by the formula

$$L = \frac{4\pi N^2}{10^9} \cdot \frac{a}{\frac{l}{\mu A} + \frac{\delta l}{A}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

and a second portion due to the mutual flux $\Phi$ calculable similarly by

$$L_0 = \frac{4\pi N^2}{10^9} \cdot \frac{1}{\frac{l}{\mu A} + \frac{\delta l}{A}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

**The Circuit Problem.**

The circuit to be considered has already been shown in Fig. 3 except that in that figure the capacity $C_1$ is to be ignored as being negligibly small on account of the pancake winding construction used. The resistance due to core loss in the transformer as well as the secondary resistance $r_2$ of the input circuit of the tube will also be omitted from immediate consideration. The general effect of these resistances is to slightly change the actual values of the coupled resonance frequencies, and to reduce the maximum values of the humps in the resonance curves. They also cause the latter to flatten out considerably. It seems quite unnecessary to attempt to take these resistances into account in an accurate circuit solution for the location of the range of wavelength operation of an amplifier, particularly in view of the fact that they are both functions of frequency as are also $C_2$, $L_1$ and $L_2$. In addition all of the quantities $r_0$, $r_2$, $L_1$, $L_2$ and the coefficient of coupling depend to a certain extent upon the strength of the signal involved. The principal effect is the dulling or flattening out of the resonance curve and in this respect the core loss plays an important rôle. In certain transformers that have been built by the author, this resistance is of the order of 1,000 ohms at 200,000 cycles under working conditions.

The circuit then to be treated is that of Fig. 11. The matter to be investigated is the variation of secondary voltage $v''$, or what is the same thing the secondary current $i_3$, with frequency under the influence of the constant voltage $ve_g = v$. Indicating the currents conventionally as shown, we get the Kirchoff equations (where $p = j\omega$)

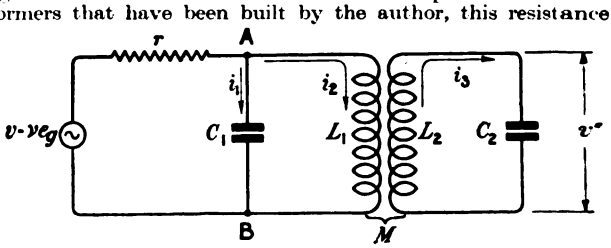


*Fig.* 11.

$$v = i_1\left(r + \frac{1}{pC_1}\right) + i_2 r \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

$$0 = -\frac{i_1}{pC_1} + pL_1 i_2 - pMi_3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

$$0 = -pMi_2 + \left(pL_2 + \frac{1}{pC_2}\right) i_3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (23)$$

From these we get by routine methods

$$I_3 = \frac{V}{\sqrt{\left(\frac{L_1C_2L_2(1-K^2)\omega^2 - L_1}{\omega K\sqrt{L_1L_2C_2}}\right)^2 + \frac{r^2}{\omega^4 C_2^2 K^2 L_1 L_2}\left(1 - \omega^2(L_1C_1 + L_2C_2) + \omega^4 L_1C_1L_2C_2(1-K^2)\right)^2}} \quad (24)$$

$$= \frac{V}{Z} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (25)$$

The desired conditions are those giving maximum values of this expression. Such conditions obviously obtain when the denominator has minimum values and can be determined by equating

$$\frac{d(Z)^2}{d\omega} = 0$$

Such procedure gives

$$0 = 2\omega^8\left[L_1^2L_2^2C_1^2C_2^2(1-K^2)^2r^2\right] + \omega^6\left[L_1^2L_2^2C_2^2(1-K^2)^2 - 2L_1L_2C_1C_2r^2(1-K^2)(L_1C_1 + L_2C_2)\right] +$$

$$+ \omega^2\left[2(L_1C_1 + L_2C_2)r^2 - L_1^2\right] - 2r^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (26)$$

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The solution of this equation for $\omega$ and the selection of the proper roots is quite a formidable task mechanically. It can be most simply accomplished by graphics, but is cumbersome at best and since the coefficients themselves are functions of $\omega$ the tedium of the work is still further increased. The solution of the problem from (24) is in fact so complex and the accuracy of the results so doubtful on account of the difficulty of accurately formulating the coefficients in terms of $\omega$, that to the practical designer the procedure would be most uninviting. It seems very important to make simplifying approximations.

Consideration of (24) shows a way out of the difficulty. It will first be observed that the denominator of this expression comprises two terms. The second term involves $r$ as a factor and its influence on the value of $I_3$ therefore increases when $r$ is large and becomes negligible when $r$ is very small. In the latter case the impedance $Z$ is given practically by the first term of the denominator and is equal to zero, giving maximum current and secondary voltage when

$$L_1L_2C_2\,(1-K^2)\,\omega^2 - L_1 = 0$$

or when

$$\omega^2 = \frac{1}{L_2C_2(1-K^2)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (27)$$

that is at only one frequency. On the other hand, if $r$ is so large that the first term can be ignored then the impedance $Z$ becomes zero when

$$\omega^4L_1C_1L_2C_2(1-K^2) - \omega^2(L_1C_1 + L_2C_2) + 1 = 0$$

or when

$$\omega^2 = \frac{L_1C_1 + L_2C_2 \pm \sqrt{(L_1C_1 - L_2C_2)^2 + 4K^2L_1C_1L_2C_2}}{2(1-K^2)L_1C_1L_2C_2} \qquad \ldots\ldots\ldots \quad (28)$$

which is the familiar expression giving the oscillation frequencies of a pair of inductively coupled circuits. Practically, neither one of these two extreme conditions exists, but both terms of (24) are effective thus giving two minima whose location just now is rather obscure.

Inspection, however, shows the following facts. The first term of the denominator varies with the frequency somewhat according to the curve A, Fig. 12. The second term varies according to curve B. If the first term (curve A) were not effective the two frequencies giving maximum amplification would be determined by the usual coupled circuit equation (28) and would be located at $f_0'$ and $f_0''$ (Fig. 12) where the B curve touches $f$ axis. The presence of the first term (curve A) however makes the resultant impedance curve (curve A + curve B) take the form of curve C. *The two minima are brought closer together. Thus as far as the location of the minima are concerned the effect is the same as though*

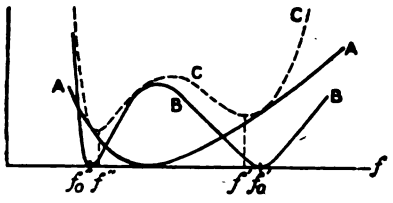


*Fig.* 12.

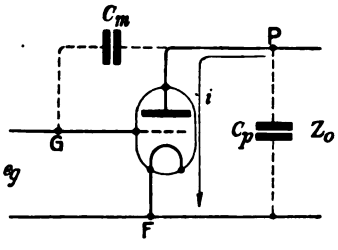


*Fig.* 13a.

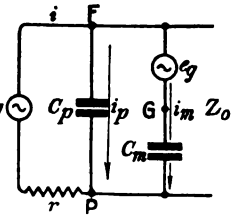


*Fig.* 13b.

*the coefficient of coupling in the second term had been decreased.* The suggestion immediately presents itself therefore that as an approximation the actual minima may be located by considering the second term alone using its condition for minima (28) but modified by considering the coefficient of coupling reduced so that $K^2$ can be neglected in comparison with unity. The conditions for maximum amplification would then become more simply

$$\omega^2 = \frac{\frac{1}{L_1C_1} + \frac{1}{L_2C_2} \pm \sqrt{\left(\frac{1}{L_1C_1} - \frac{1}{L_2C_2}\right)^2 + \frac{4K^2}{L_1C_1L_2C_2}}}{2} \qquad \ldots\ldots \quad (29)$$

There are several further features, however, which must be considered before the form of (29) can be accepted for practical calculations. In the first place $C_1$ is a most uncertain quantity and is one of the factors which makes the rigorous solution of (24) so difficult. Secondly, since $K$ has been considered as reduced below its actual value in the formulation of (29) the question arises as to what value should be used for it in that equation.

As regards the stated variation of $C_1$, this may be readily understood from the following elementary analysis. The No. 1 or input tube is shown in Fig. 13. The actual circuit is shown at (a), and its

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analytical equivalent at (b). Across the load $Z_0$ appears the alternating voltage $re_g(r \neq r_0)$. This voltage is associated with the current $i_p$ in the relation

$$i_p = re_g\omega C_p$$

The current $i_m$ is also identified with this voltage $re_g$ but in addition there is the grid voltage $e_g$ acting serially additive to $re_g$ giving

$$i_m = (r + 1)\, e_g C\omega_m$$

The total capacity current is therefore

$$i_p + i_m = re_g\omega \left[ C_p + \left(1 + \frac{1}{r}\right) C_m \right]$$

The effective capacity $C_1$ is seen to be

$$C_1 = C_p + C_m \left(1 + \frac{1}{r}\right)$$

This value will, of course, be somewhat modified by the nature and magnitude of the impedance supplying $e_g$ and the exact phase of $e_g$ with respect to $re_g$. The general nature of the effects determining $C_1$ is well indicated, however, and explains the statement just made regarding the variation of this quantity. It will be obvious that an approximation to $C_1$ is highly desirable if not, in fact, essential. The one which we shall make is $C_1 = C_p + C_m$.

Now, referring to (28), it will be seen that using $C_1 = C_p + C_m$, which is smaller than its actual value, operates on the separation of the two resonant frequencies in a contrary manner to reduction of $K$. What is desired, according to the indications of Fig. 12, is to somewhat raise the lower resonant frequency $f''_0$ as determined from (28) and lower the higher resonant frequency $f_0'$ (generally a somewhat greater amount).

It is noted that the quantity $(1 - K^2)$ in the denominator increases for the higher frequencies tending toward unity as $K$ falls off. It may also be noted that the two resonant frequencies $f'$ and $f''$ will be expected somewhere in the neighbourhood of the natural frequencies of oscillation of the individual circuits. This suggests the determination of these natural frequencies. Now, $L_1$ and $L_2$ are larger for low frequencies than for high ones, so that if their inductance values as identified with the separate natural oscillations of the two circuits are used in (28) it will be evident that in the neighbourhood of the lower coupled circuit frequency ($f''$), $L_1$ will be considerably lower than its actual value, which would have had to be used in the solution of the complete equation (24), and $L_2$ will likewise be somewhat lower than its actual value, though the difference will not be so great as with $L_1$, since $f''$ and $f_2$ will probably not be widely different. Similarly, in the neighbourhood of the higher coupled circuit frequency ($f'$) $L_1$ will be nearly correct or a little high, and $L_2$ will be considerably higher than its actual value.

Under these conditions and when using the minus sign for the radical it will be seen that the lower frequency $f''$ of (28), wherein actual values of all the quantities would be used, will move upward somewhat by the use of (29) wherein

$L_1$ = value of $L_1$ for independent primary circuit resonance.

$L_2$ = value of $L_2$ for independent secondary circuit resonance.

$K$ = actual values of $K$.

$C_1 = C_p + C_m$ (lower than actual value).

Likewise the higher frequency $f'$ of (28) will be reduced by the use of (29) with its approximations. These conclusions are, of course, quite general in nature. They indicate, however, that the approximations stated are operative in the right direction and result in comparatively simple calculations for the practical designer. Equation (28) cannot be used *per se*, and the complete expression (24) is prohibitively cumbersome even after assuming some average value of $C_1$.

According to the contemplated method we are to calculate the location of the peaks of the amplification characteristic from (28) which is now to be written thus —

$$f' = \sqrt{\frac{f_1^2 + f_2^2 + \sqrt{(f_1^2 - f_2^2)^2 + 4K^2 f_1^2 f_2^2}}{2}} \qquad (30)$$

$$f'' = \sqrt{\frac{f_1^2 + f_2^2 - \sqrt{(f_1^2 - f_2^2)^2 + 4K^2 f_1^2 f_2^2}}{2}} \qquad (31)$$

$$f_1 = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

$$f_2 = \frac{1}{2\pi\sqrt{L_2 C_2}}$$

$$K = \frac{M}{\sqrt{L_1 L_2}} = \frac{1}{1 + a}$$

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**Determination of Free Frequencies $f_1$ and $f_2$ and proper Correlation of $K$.**

The formulæ previously developed for the inductances and coefficient of coupling involve the permeability $\mu$ of the iron core. The permeability is not constant but varies with the frequency. For the kind of iron used at these laboratories (Alexanderson low carbon steel 1½ mils thick), it has been found that the relation between permeability and frequency for small flux densities can be very closely expressed as follows:—

$$\mu = \frac{3{\cdot}02 \times 10^5}{f^{0{\cdot}6}} \quad \text{from 200,000 to 1,500,000 cycles} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (32)$$

$$\mu = \frac{2{\cdot}6 \times 10^4}{f^{0{\cdot}4}} \quad \text{from 200,000 to 75,000 cycles} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (33)$$

In determining the location of the peaks of the resonance curve of the transformer, that is, the frequencies $f'$ and $f''$ of (30) and (31) the natural frequencies $f_1$ and $f_2$ of the primary and secondary circuits must be known. At first sight these seem to be somewhat ambiguous because the inductances $L_1$ and $L_2$ are themselves functions of frequency depending upon the core permeability. The problem is presented, therefore, of determining the natural frequency of oscillation of a circuit comprising an iron core inductance. It can be solved most simply by a graphical method as follows.

Let $L = \phi(f)$, as determined from the dimensions of the coil and core, and permeability of the latter. Also let $L = \psi(f)$ be the functional relation between the frequency, the inductance of the coil and the capacity with which the latter is associated. Obviously

$$L = \psi(f) = \left(\frac{1}{4\pi^2 C}\right) \times \frac{1}{f^2}$$

while $L = \phi(f)$ is calculated from the formulæ previously given as (17) and (18). If the two functions $\psi(f)$ and $\phi(f)$ are plotted on the same sheet they will be found to intersect as at P, Fig. 14a, and the frequency corresponding to this intersection point will be the frequency at which the circuit will stabilise in free oscillation. In any particular design the natural frequencies $f_1$ and $f_2$ are thus determined.

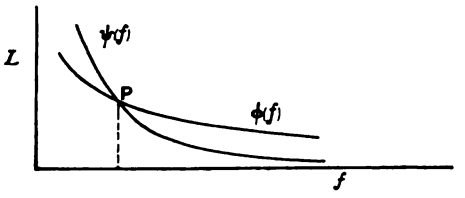


*Fig.* 14a.

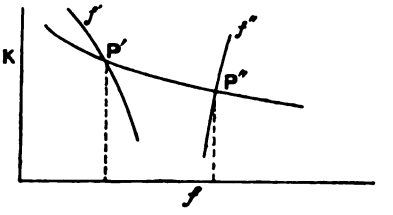


*Fig.* 14b.

A further ambiguity arises in the calculation of $f'$ and $f''$ owing to the variation of $K$ with frequency, but this is also satisfactorily solved by a graphical method. Having determined $f_1$ and $f_2$, as just described, $f'$ and $f''$ are plotted as functions of $K$ according to (30) and (31). The functional relation between $K$ and frequency as determined from the geometry of the transformer, etc., by formulæ (15), (32) and (33), is also plotted on the same sheet (see Fig. 14b). The intersections of this curve with the two curves of $f'$ and $f''$ as at $P'$ and $P''$ (Fig. 14b) determine the values of $f'$ and $f''$ at which the resonant humps occur.

In many cases it will be found that this second graphical step is not strictly necessary, as a very fair approximation may be had by using a value of $K$ corresponding to a frequency about midway between $f_1$ and $f_2$, and calculating $f'$ and $f''$ directly from (30) and (31) using this average value.

**The Tube Capacities.**

The capacities $C_1$ and $C_2$ of Fig. 3 are required in order to predict the operational characteristic. Denoting—

$C_g$ = capacity between grid and filament.

$C_m$ = capacity between grid and plate.

$C_p$ = capacity between plate and filament.

We have, according to the approximation previously stated, $C_1 = C_p + C_m$

As regards $C_2$ there are two cases which must be differentiated, first, when the tube on the secondary of the transformer is used as detector with by-passing radio frequency condenser across its output, as is usual practice; and, second, when the secondary tube is another radio frequency amplifier with transformer similar to the one under consideration in its plate circuit. In either case $C_2$ may be taken as $C_2 = C_g - (1 + \nu') C_m$ where $\nu'$ is the voltage amplification factor. In the case of the detector with

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radio frequency by-pass condenser in the plate circuit $\nu'$ is obviously zero because of the short-circuiting effect of such by-pass condenser on the plate. Therefore, in this case $C_2 = C_g + C_m$

In the other case where the tube is a unit in another stage of amplification $\nu'$ has a variable value with frequency depending upon the impedance of the transformer in its plate circuit. As a maximum value it will, of course, approach the amplification constant $\nu$ of the tube, but will generally be somewhat less than this because the impedance of its plate transformer will not be infinite. Experiment has shown, however, that except for very short wavelengths the effective resistance of the load (transformer) at its tuning points is of the order of 100,000 ohms so that the error in assuming $\nu' = \nu$ is not large. For wavelengths of the order of 400 metres experiment also has indicated that the effective resistance falls to about one-tenth the value just given for long waves (1,000 metres and over), and the value of $\nu'$ is therefore more nearly equal to $\nu/2$*. Such approximations as these are convenient and sufficiently accurate to formulate the design.

It is important to note, according to the formulæ just given, that in a cascade multi-stage amplifier-detector system using identical coupling transformers throughout, the wavelength range of the last stage of amplification will be different from the stages preceding because the last stage works into the detector tube. This condition will, in general, tend to flatten out and broaden the tuning characteristics of the system, making it more nearly uniform in its response to different frequencies over a certain range. If it is desired to avoid this effect as for sharp tuning to a single frequency the last transformer in the series should be arranged with a different secondary than those preceding according to the difference in the value of $C_2$ with which it operates.

For the American type VT-1 tube, which tube is most frequently used in Signal Corps receiving equipment, we have the average values

$$C_g = 15$$
$$C_m = 13$$
$$C_p = 13$$
$$\nu = 6{\cdot}5$$

*(To be concluded.)*

# Notes

### Maritime Wireless News.

News circulated to ships at sea which has been radiated by the Marconi Company for the last twenty years from Poldhu will from May 1st, be transferred to Clifden, thereby increasing the radius by 1,000 miles, making the distance over 2,500 miles.

The news will be transmitted on a wavelength of 5,750 metres, spark.

### The Postmaster-General on Telephony Broadcasting.

In the House of Commons on April 3rd, the Postmaster-General, in reply to a question put by Sir Douglas Newton, said that the whole question of the broadcasting of wireless telephone messages was being referred to the Imperial Communications Committee. The Postmaster-General expressed his sympathy with the idea.

### The Genoa Conference.

It is understood that the wireless station at Spezia (ICS) will be used for the transmission of press news relative to the Genoa Conference. The station at Spezia consists of a Marconi 15 kW valve set. The transmissions will, it is understood, be made on a wavelength of 3,400 metres C.W. at 1,500 G.M.T.

### Marriage of Wireless Interest.

The marriage took place on Monday, the 13th March, of Lieut. Duncan Sinclair, of the Department of Civil Aviation, Air Ministry, to Doris Elsie, only daughter of the late G. W. Brind, Esq. Lt. Duncan Sinclair, it will be remembered, was the author of a paper entitled "The Wireless Stations of the British Commercial Airways," read before the Wireless Society of London.

**Mr. A. E. Hay,** of "Glendale," Abernant, Aberdare, S. Wales, would be glad to hear from anyone prepared to listen for telephony, tonic train, and spark signals from his station. The following stations are received well by him:— **2 IV, 2 MM, 2 OM, 2 KQ, 2 DX, 2 TV, 2 HM,** or **2 HW** (presumed to be a Bristol station), **2 PZ, 2 IQ.** Mr. Hay states he is heard regularly up to distances of 150 miles. His call is **2 KG.**

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

Sir,—On opening the March issue of *The Radio Review* this morning and reading over my review of Leggett's "Wireless Telegraphy," I see that I have done the author an injustice, due to misunderstanding a sentence in the book. I refer to lines 10 to 14 in my review, where I expressed surprise at the author's suggestion that the well-known books by Fleming, Hawkhead, and Eccles were not written by actual wireless engineers but contained matter largely obtained second-hand from other books. On reading over the quotation again, however, I see that it bears quite a different construction to that which I placed upon it, and that the author intended no such suggestion, but rather referred to the three authorities named as the sources from which other writers obtained their second-hand matter. It is also obvious that, in making the statement that, with very few exceptions books dealing with wireless telegraphy are not

*For resistance load $R$, and tube resistance $R_0$, $\nu' = \frac{R}{R + R_0}\nu$

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written by actual wireless engineers, Mr. Leggett regarded the three authors named as among the exceptions.

Having criticised several features of the book, I am the more anxious to correct at once what is obviously an injustice to the author.

G. W. O. H.

*April 5th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The following appeared on page 571 of "Tit-Bits" (issue dated February 25th) :—

HORSE-POWER BY WIRELESS.

" . . . and now a big *wireless power station* is working in Germany. Great towers, more than a hundred feet high, transmit current across the River Elbe to distant factories."

I should be very much obliged for any information available regarding the system and wavelength used.

This is not idle curiosity—far from it—as I listen in at night I scarcely dare vary my A.T.C. for fear I should touch a harmonic of the wavelength of this new station. To those building their own tuners I would point out the awful consequences resulting from a miscalculation of inductance or the presence of a rusty iron nail in the coil.

I cannot sleep at night for thinking of the dangers that beset my brave colleagues—what if a strong gust of wind should for one brief second deflect the beam on to a resonant aerial ?

At the same time the possibilities of this invention are boundless.

We may expect to see things like this in our newspapers in the near future :—

ORIGINAL SUICIDE AT PECKHAM !

" A verdict of ' suicide during temporary insanity ' was recorded at the inquest on the charred remains of R. Adiobug.

" It appears the lad, still in his teens, had just had the misfortune to ' burn out ' one of his precious wireless valves. This seems to have turned his mind, for a witness of the tragedy states that the poor lad feverishly fitted up a crystal receiver, placed the 'phones on his head, and taking a deep breath, unhesitatingly turned the A.T.I. switch of his tuner on to the thirteenth and last stud. The coroner expressed his deepest sympathy with the parents of the young lad, but pointed out the dangers of his hobby."

We may even expect to see something like this in our *trade* papers :—

INGENIOUS INVENTION.

" Messrs. A.B.C. have just put on the market their new ' Radio Rat-trap ' (Patent 706941). This should be a good selling line, absolute and unfailing reliability combined with its extreme simplicity.

" The weight of the rat on a board automatically closed the secondary circuit of a radio receiver tuned to the ' National Wireless Power Station,' at the same time making electrical contact with the rat and assuring its sudden, painless and odourless demise."

The advertisement pages of *The Wireless World* may be filled with the announcements of enterprising undertakers, setting forth the advantages of the new system of radio cremation to careless amateurs.

To those possessing a good aerial there will doubtless be facilities for home cremation in the shape of portable crematoriums.

It is even possible that the principal firms of wireless apparatus makers will offer special free life insurance policies to those purchasing their " Harmonicless " tuners.

I feel sure you will agree with me that, after all, there really is a future in wireless.

" MILLY AMPERE."*

# Books Received.

THE STRUCTURE OF THE ATOM. By Stephen Miall. (London : *Benn Brothers, Limited*. Pp. 26. 8½" × 5½". Price 1/6 net.)

LA T.S.F. DES AMATEURS. By Franck Duroquier. (Paris : *Masson & Cie.* Pp. 305. 315 figs. 7" × 4½". Price 10 fr.)

# Calendar of Current Events

**Tuesday, April 11th.**

Transmission of Telephony at 7 *to* 7.25 *p.m.* on 700 metres followed by C.W. Calibration Signals on 1,000 metres, by 2MT at Writtle, near Chelmsford.

**Wednesday, April 19th.**

NORTH MIDDLESEX WIRELESS CLUB.

8 *p.m.*—At Shaftesbury Hall, Bowes Park, " Electro-Chemistry," by Mr. R. Maxwell Savage, B.A.

COWES AND DISTRICT RADIO SOCIETY.

" Independent and Self Heterodyne Methods."

**Friday, April 21st.**

WIRELESS SOCIETY OF HIGHGATE.

7 *p.m.*—Lecture and demonstration by Lieut. Walker.

BRADFORD WIRELESS SOCIETY.

7.45 *p.m.*—At 5, Randallwell Street, Bradford. Meeting.

**Wednesday, April 26th.**

RADIO SCIENTIFIC SOCIETY, MANCHESTER.

Smoker and Exhibition.

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (Tea 5.30 *p.m.*). At the Institution of Electrical Engineers, Victoria Embankment, W.C.2. " The Four Electrode Valve," by Captain H. de A. Donisthorpe.

**Thursday, April 27th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

" A System of Recording and Demonstration," by Mr. L. Haggard.

**Friday, April 28th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

*Selected*. Mr. A. F. Carter, A.M.I.E.E.

* Our correspondent should not be taken too seriously.—ED.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Cambridge University Wireless Society.*

A meeting of the Society was held on Monday, February 20th, when Mr. E. B. Moullin read a paper entitled "Measurement of Strength of Signals." In this he described in detail experiments he had carried out in measuring the strength of Horsea press signals. The method employed was to compare the signals received in the aerial with those produced in an equivalent concentrated circuit loosely coupled to a triode oscillator. The results obtained showed quite small variations over a considerable period of time and pointed to an accuracy of approximately 10 per cent. The meeting concluded with an informal discussion.

On Monday, February 27th, Mr. P. R. Coursey read a paper before the Society entitled "Some Methods of Modulation in Wireless Telephony." He first dealt with the use of a saturated diode, or triode, to replace the choke coil commonly used in telephony circuits, and showed that the system possesses the advantage of giving the same degree of modulation with sounds of any frequency. He then explained the possibility of controlling the input to the power value by means of applying the speech voltages direct to the grid of the saturated valve, and showed that, if this effect is carried to the limit, it gives a nearly "quiescent aerial" transmission, the saturated valve passing very little current, and hence allowing only very weak oscillations in the aerial, until the speech voltages are applied to the grid. He demonstrated by curves taken from his experimental results, how important it is to keep the filament temperature exactly right, and also that the variations of oscillatory current with applied speech voltage obey approximately a linear law, and therefore make for distortionless modulation. The meeting closed with a hearty vote of thanks to Mr. Coursey, proposed by Mr. E. V. Appleton.

On March 1st thirty-six members of the Society visited the Marconi Company's works at Chelmsford. An extremely interesting afternoon was spent in inspecting the various workshops and testing-rooms. Not the least interesting of the apparatus seen was the high-speed set for working with Paris, which was seen in operation.

On Monday, March 6th, Mr. E. H. Shaughnessy gave a lecture to the Society on the "Leafield Station of the Imperial Wireless Chain." He briefly explained the principle of the Poulsen arc system, and then proceeded to describe the various parts of the station with the aid of lantern slides. In conclusion, he showed a number of slides of various high-power stations in England and abroad, and gave figures obtained by the Post Office Experimental Station to show that the power transmitted on harmonics by Leafield was by no means excessive, and he remarked that it was mainly due to the inefficiency of amateur receiving apparatus that so much was heard of jamming on harmonics by that station. In conclusion, a hearty vote of thanks was accorded Mr. Shaughnessy; also the Secretary was asked to convey the thanks of the Society to Captain P. P. Eckersley for his kindness in arranging the visit to Chelmsford.

Hon. Secretary, Mr. D. A. L. Wade, 16, Trumpington Street, Cambridge.

### Burton-on-Trent Wireless Club.*

A meeting of the Burton-on-Trent Wireless Club was held at the *Burton Daily Mail* office on March 10th, and there was a most encouraging attendance, over which Mr. L. Sims presided.

A lecture on "The Electrical Constitution of Matter" was given by Mr. J. Shercliff, B.Sc. The lecturer dealt in a thorough and highly interesting way with electron energy, and gave a most entertaining and spectacular demonstration with Crookes' tubes, Geizler tubes and the Tesla coil.

Mr. F. V. A. Smith presided at a meeting of the Club held at the *Burton Daily Mail* office on March 24th, when Mr. A. J. Selby gave a demonstration on the B.T.H. portable wireless set, and also on one of his own manufacture. He explained the advantages and disadvantages of various types of high and low frequency transformers and their use in receiving messages. Signals were received on the B.T.H. set and the directional properties of the frame aerial were pointed out by actual experiment.

The Chairman explained some wireless transformers of his own construction, which were very simple and easy of manipulation, and gave results equal to some of the best on the market.

A lengthy discussion followed. It was interesting to know that on this type of transformer the American amateurs sent out their messages and were heard in this country.

The customary votes of thanks, including one to Mr. A. J. Wright for the loan of his B.T.H. set, terminated a most enjoyable and instructive gathering.

### The West London Wireless and Experimental Association.*

At the meeting held on March 23rd Morse practice was given by Mr. Winnett. The President (Mr. George Oxford) was elected an Honorary Member of the Association for his early labours in connection with the formation of the Association under its original title, "Chiswick, Acton and District Wireless Association." Mr. Oxford suitably replied, and thanked all for the honour bestowed upon him.

A paper entitled "H.T. from House Lighting," submitted by Mr. A. E. C. Roylance, one of our members at present in Elgin, was read by the Secretary. Mr. Roylance, having omitted his address from his letter, the members take this

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opportunity of tendering to him their hearty thanks through the medium of this report.

The Vice-President (Mr. F. E. Studt) gave a paper entitled "A Short Wave Tuner," and exhibited two which he had himself made, and, by diagrams on the blackboard, described the method of construction.

The Secretary wishes all interested to make a note of the following:—

Mr. Horace W. Cotton, Hon. Secretary, will be pleased to reply to any applicants for particulars of membership if they will communicate with him at his address, 19, Bushey Road, Harlington, Middlesex.

### Woolwich Radio Society.*

The monthly general meeting of the Society was held on Friday, March 31st, 1922, at the Woolwich Polytechnic, at 8 p.m. A good audience gathered, including several lady visitors.

Our Assistant Secretary (Mr. A. G. Beeson) was the speaker, and he chose for his subject "X-rays." Mr. Beeson had brought with him a large amount of apparatus, including many vacuum tubes and two X-ray tubes. He began by briefly recounting the early history of the investigation of electrical discharges in rarefied gases. Reference was made to the valuable work of Sir W. Crookes. A Crooke's tube was shown to illustrate the phenomena of fluorescence and a nitrogen tube to illustrate the after-glow.

The experiments of Lennard were touched upon, and lastly the X-rays themselves. Using a large X-ray tube and the 10-inch spark coil (kindly loaned by the authorities of the Polytechnic), Mr. Beeson showed some of the marvellous properties of these rays, the ease with which they pass through light metals, flesh and aluminium, and the opacity of denser substances. Mention was made of the Cooledge tube, with which so much valuable work was done during the war.

Finally the lecturer gave a brief description of radium, with its wonderful series of rays, and pointed out the similarity between the radium emissions and X-rays. The X-ray apparatus was then set going, and members of the audience spent an interesting half-hour in exploring the mysteries of these rays for themselves.

In bringing the interesting evening to a close Mr. McPherson, B.Sc. (our Chairman), added a few remarks about the Cooledge tube, and also pointed out the dangers of prolonged exposure to these rays, instancing the cases of those great scientists who have given their lives in this cause. A hearty vote of thanks by the Chairman, seconded by Mr. W. T. James, brought the meeting to a close.

The Woolwich Radio Society holds weekly meetings at the Y.M.C.A., Woolwich, every Wednesday evening, except the last in the month, at 7.30 p.m. A station is installed and telephony is received strongly each week, besides plenty of other signals. A buzzer class is held from 7.30 to 8 p.m. for beginners.

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

### Wireless and Experimental Association.*

The Wireless and Experimental Association at the Central Hall, Peckham, on Wednesday, March 29th, held a prize competition for the design of apparatus. Two prizes had been offered by the Chairman (Mr. A. W. Knight), but so keen was the competition that this was enlarged to four. The Secretary (Mr. George Sutton) carried off the first prize, the second was tied between Major Webb and Mr. W. G. Noakes, while our junior member and energetic Boy Scout, Mr. E. W. Smith, secured the third prize for a very ingenious piece of apparatus. There were fourteen entries and the four adjudicators chosen from the mechanicians, electricians, operators and beginners' classes had no easy task to judge fairly. A vote of thanks was moved by Major Webb and seconded by Mr. Voigt.

Hon. Secretary, Mr. Geo. Sutton, A.M.I.R.E., 18, Melford Road, S.E.22.

### Hounslow and District Wireless Society.*

An open meeting was held on Thursday, March 30th, at the Society's headquarters, about fifty being present. By the courtesy of the Marconi Scientific Instrument Co., Mr. Oswald Carpenter, Associate I.R.E., attended to deliver a lecture. He started by giving a short history of the early struggles of Senatore Marconi from his first discoveries up to almost the present day. He showed lantern slides relative to Marconi wireless stations and apparatus, explaining everything as he went along. He asked for questions on wireless, and many were asked and answered. Afterwards he demonstrated a Marconi 5-valve receiver with loud speaker. Signals of all descriptions were received and heard all round the room and explained by Mr. Carpenter.

The Chairman proposed a vote of thanks to Mr. Carpenter and all members applauded heartily. The meeting closed at 10.30 p.m., all members being exceedingly pleased and satisfied.

Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow.

### Sussex Wireless Research Society.*

Hon. Secretary, Mr. Edward Hughes, B.Sc., A.M.I.E.E., The Technical College, Brighton.

At a meeting of the above Society, held on March 15th, various business matters were discussed at length, after which the President (Captain Hoghton, M.Inst.P.), gave a short lecture on "C.W. Transmitter Circuits," in the course of which he described some interesting and extremely ingenious forms of microphones. The action of the "Dynatron" and its application to transmitter circuits were also discussed.

At a meeting held on March 22nd, Mr. J. W. Ray gave a lecture on "Secondary Batteries." Different types of batteries were described, and sample components of both the acid and the alkaline cells were exhibited. Mr. Ray also dealt with the application of storage batteries to telegraphy and telephony circuits, and with the various precautions that are taken to ensure a battery being maintained in a healthy and reliable condition.

### Bolton Wireless Society.*

Hon. Secretary, Mr. H. Chadwick, 9, Raimond Street, Halliwell, Bolton.

The Society was again favoured, on March 17th, with another visit of Mr. J. McKernan, of the Manchester Wireless Society. The subject of his lecture was "Selenium Cells: their Construction, Care and Application." The construction of various types of cells was explained, and the peculiar phenomena attached to this little-known substance.

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Its application to practical working was described and followed by practical experiments, such as lighting a lamp, ringing a bell and starting a motor by means of a beam of light. A full description of this lecture was given in a recent report of the Manchester Wireless Society.

At the conclusion of the lecture several questions were asked and Mr. McKernan cleared up many little points regarding the nature and application of selenium, after which a further discussion on high-frequency current took place, several members having formulated a few ideas on H.F. work since Mr. McKernan's previous lecture. A vote of thanks, proposed by Mr. Parkinson, was heartily accorded by the meeting.

A Special General Meeting was held on March 28th for the purpose of passing new rules, which had been drawn up by the Committee. This business over, the Hon. Treasurer (Mr. J. Waller) presented the whist drive balance sheet, which showed a profit of £5 4s. This account was approved and a vote of thanks was proposed by Mr. Rawsthorne to all who had helped to make the whist drive a success.

Mr. Parkinson then gave a lecture on the "Manufacture of Wireless Telegraphic Apparatus," many useful hints being given on making inductances, condensers and the use of solder. The meeting closed with a vote of thanks to Mr. Parkinson, which was given with acclamation.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

The fourth meeting of the Southampton and District Wireless Society was held at the Kingsland Assembly Room on Wednesday last, March 29th; a good attendance was recorded. It is satisfactory to state that for the first month's work of this society fourteen new members have been enrolled, the club aerial erected, and rule cards, etc., issued. The first four weeks have been devoted to experimental work with various member's sets, and good results have been obtained. It is the intention of the society to get first-class lecturers, and the month of April has been given over for lecturing, with the usual thirty minutes' buzzer practice. Demonstrations will shortly be given, and very interesting evenings are anticipated. The society hold their meetings every Wednesday at 7.30 p.m., and anyone interested will be cordially welcomed. The annual fee for membership is 12s.

### St. Austell Wireless Club.

Hon. Secretary, Mr. H. Whetter, 26, Fore Street, St. Austell.

The second Annual Meeting of the above Club was held in the Queen's Head Hotel on Monday, March 20th. The attendance was very good. Mr. W. H. Graham, of Tywardreath (Cornwall's first amateur), took the chair, and proved himself a most capable chairman, especially when it came to giving some helpful advice on the management of club affairs. He was unanimously elected President for 1922.

It is hoped to have several field days during the summer months.

### Grimsby and District Radio Society.

Hon. Secretary, Mr. J. H. Perkins, 35, Hare Street, Grimsby.

A meeting of the above Society was held in the Club-room, Welldigate, on Tuesday, March 28th. The Marconi Concert was received quite loud on Mr. Wood's (Vice-President) 3-valve H.F. amplifier.

Meetings are held each Tuesday from 7 p.m. to 10.30 p.m., and anyone interested will be cordially welcomed.

### Wolverhampton and District Wireless Society.

A well-attended meeting of the above Society was held on Wednesday, March 29th, at headquarters, 26, King Street, Wolverhampton. Mr. H. Taylor gave a very interesting discourse on high-frequency amplifiers. With the aid of diagrams drawn on a blackboard he was able to illustrate his remarks, so that even the uninitiated could grasp the subject. The discourse lasted over an hour and was much appreciated.

Membership cards are now being issued; all local radioists should have one. Apply to the Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, or 26, King Street, Wolverhampton.

### Brighton Radio Society.*

At the meeting of the above Society, held at its headquarters in Buckingham Road, on March 23rd, a most interesting paper was read by Mr. James Cowie, A.M.I.E.E., entitled "Recent Developments in Experimental Psychology." The lecturer outlined most clearly how beneficial the application of this fascinating subject would be to the wireless experimenter in the pursuance of entirely new ideas somewhat off the beaten track. The large number of members present indicates the keen interest which is being taken by Brightonians in the development of wireless telegraphy, and there is no doubt that valuable assistance will be rendered to the local experimenters who were fortunate enough to hear the lecture.

The Society continues to swell its membership daily, and now that the Postmaster-General has granted the necessary licence for the installation of a transmitting set, a large number of intensely interesting experiments in wireless telephony, etc., will be carried out during the current year.

Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full details as to membership, etc.

### The Wallasey Wireless and Experimental Society.

At the meeting of the Society held at 106, Albion Street, New Brighton, on Thursday, March 16th, Mr. W. F. Mills treated the members to a most interesting discourse on "Wireless for Beginners." Owing to the fact that the Society is a new one, and at least half of its membership are beginners, the lecture could not have been more valuable.

## CORRECTION.

The stations referred to in Mr. Yardley's lecture before the Leeds and District Wireless Society, reported in the March 18th issue, should have been **2 LA** and **2 LB** and not **2 NA** and **2 NB**, the latter being the stations of Mr. J. Barnaby, Sylvan House, Broad Road, Manchester.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) Four questions is the maximum which will be accepted at a time.*

**"H.J." (Harrow)** *is having severe trouble with a motor on the premises, and asks for advice.*

We are not quite clear from your letter whether the supply for the motor is also used for the set. The symptoms point to a small armature fault on the motor. The most likely cure we can suggest is to put a large capacity between each brush of the motor and earth. We do not think a screen to the motor will be very useful, but you might try it if it can be easily done. If the same supply is used for the receiver, put chokes in each lead near the receiver and also a large condenser across the leads.

**"R.C." (Liverpool)** *asks questions about a coupler.*

Your sample wire did not come to hand.

(1) Wind primary with No. 22, and secondary with No. 26.

(2) Two or three tappings will be sufficient.

(3) About 2,500 metres.

(4) Wavelength can be increased by adding coils in both circuits. It is useless to add coils to one circuit only.

**"RIVERESCO" (Dumfries)** *asks* (1) *For dates of issues describing a crystal set with the price.* (2) *What is the meaning of C.W.* (3) *Names and prices of Textbooks on practical work.*

(1) and (3) "The Elementary Principles of Wireless Telegraph." Part I deals with crystal receiving apparatus. There is no recent article on the subject in *The Wireless World*, as most beginners prefer to start right away with a valve receiver, owing to its ease of manipulation.

(2) C.W., or Continuous Wave, is the name applied to systems of wireless telegraphy transmission in which the amplitude of the ether strains remains constant. Continuous wave stations usually employ valves, high frequency alternators, or arcs for the production of the sustained oscillations. The use of this method, which is described more fully in textbooks, possesses many advantages, but necessitates the use of special methods and apparatus for reception.

**"BEGINNER" (Halifax)** *asks* (1) *If there is any limit to the number of valves permitted for a receiving set by the P.M.G.* (2) *If so, what the limit is.*

We do not think so unless stated on license, but in practice it is seldom of much use to employ more than about six for ordinary reception with telephone receivers.

**"S.O.S." (Swansea)** *asks* (1) *If a plate 18" × 12" buried 2 ft. deep will do for an earth.* (2) *For criticism of a circuit.*, (3) *If a filament resistance is necessary.* (4) *Where to obtain a list of call letters and what station has the call letters* **PCGG.**

(1) Plate should be considerably bigger in area and buried deep enough to lay in damp soil.

(2) The circuit is quite all right as shown except that it is liable to give re-radiation as it has only one circuit with reaction.

(3) A filament resistance is very desirable with all valves.

(4) **PCGG** is a station at the Hague sending out telephony. A full list of call stations is given in "The Wireless Year-Book," but many calls will be found in a supplement published with the January 7th issue.

**"W.F." (West Hartlepool)** *asks* (1) *If it is possible as an ex-service man to get assistance in taking a course of wireless.* (2) *What address to apply for this help.*

(1) We do not know of anything being done in this way, but should advise you to apply to the Ministry of Pensions.

**"F.W.F.L." (Chichester)** *asks* (1) *If a stage of H.F. will be better than a stage of L.F. for getting* **PCGG.** (2) *If the tuner described on page 439, October 15th, will be suitable for the reception of concerts.* (3) *If a condenser "C" in his diagram is necessary.* (4) *If a 1/1 ratio will be all right for a transformer in the circuit.*

(1) The H.F. will be distinctly the better. For circuit, see Fig. 1, January 7th issue.

(2) Yes, if proportions of coil are suitable.

(3) "C" is necessary and capacity should be about 0·001 mfd.

(4) "T" may be of ratio between 1/1 and 1/3.

**"S.G.S." (Langley Mill)** *asks* (1) *If a crystal set sketched is suitable for* **PCGG.** (2) *For size of a frame aerial for it.* (3) *If not suitable, for advice for improvement.*

(1) A crystal set is quite useless for this station at such a distance.

(2) A frame aerial is quite useless for use with a crystal set.

(3) To get this station you would require at least three valves with an outside aerial. For good results with a frame aerial on any stations not in the immediate neighbourhood you would require still more valves.

**"RENRUT" (Cambridge)** *asks* (1) *For a simple crystal circuit with valve magnification.* (2) *Whether Poldhu transmits on 2,800 metres C.W.*

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(1) The most efficient way to use a valve and crystal is with the valve as H.F. Amplifier followed by the crystal as Detector. For circuit see diagram (Fig. 1).

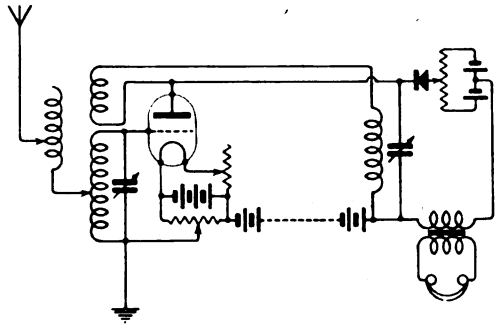

*Fig.* 1.

(2) We believe the bulk of Poldhu work is still done on the spark set, but the station possesses a C.W. transmitter which is probably used at times on this wavelength.

**"G.M." (Birmingham)** *asks for information for a simple set, preferably crystal, which he can use with a very small aerial.*

A frame will be useless to you without several valves, even a crystal will be very poor on so small an aerial as you suggest. One of the best sets you could try would be "A School Receiving Set" described in the issues of September 17th and October 29th last.

**"HIGH FREQUENCY" (Birmingham)** *asks* (1) *If it would be possible to add a stage of H.F. for his detecting valve panel.* (2) *If so, for connections.* (3) *If a Weston relay is suitable for wireless recording.*

(1) and (2) Yes, this can be done. See diagram (Fig. 2.)

(3) Yes, for fairly light duty at slow speeds.

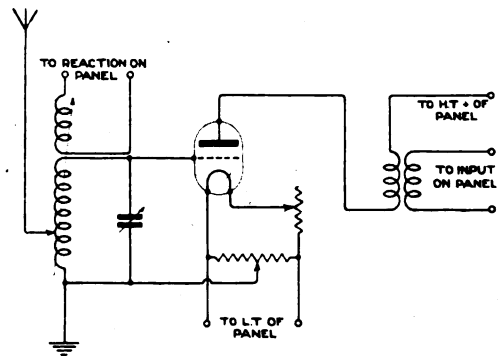


*Fig.* 2.

**"R.L." (Dulwich)** *sends a circuit for criticism and asks* (2) *If a variable condenser of 0·0002 mfd. would be suitable for it.* (3) *For dimensions of reaction coil.* (4) *How to tap the A.T.I. without unwinding it.*

(1) and (4) You will not be able to tap the A.T.I. without unwinding it, but you might fit a slider to it. This would improve the set by allowing you to connect the slider to the aerial, putting the condenser and also the filament and grid across the whole coil. This would greatly reduce the re-radiation and give better tuning.

(2) Yes.

(3) 5" × 5" of No. 28.

**"H.J." (Tunstall)** *asks* (1) *How to stop a 6-valve set from oscillating.* (2) *If he can receive 180 metres on the set.* (3) *If not, why not.* (4) *If there is anything wrong with the loud speaker which only gives a few signals weakly.*

(1) Try weakening the reaction and all couplings in the circuit; also keep the input and output leads of the valves as far from each other as possible.

(2) and (3) You should do so if the sizes of the coils, about which you say nothing, are suitable.

(4) Without more detailed information we cannot suggest the cause of the trouble.

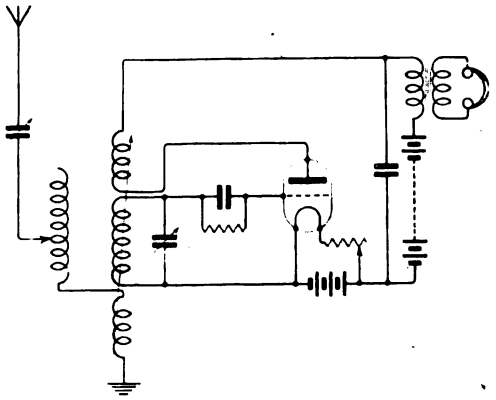

*Fig.* 3.

**"V.D.B." (Reading)** *asks various questions on the circuit on page* 396, *September* 17*th issue.*

The best way of coupling the receiving coils is to line them up on one axis as shown in your second sketch; the closed circuit coil being in the middle, reaction at one end and A.T.I. at the other. If this is done, it is generally best for the A.T.I. not to come right over the closed circuit coil. Alternatively, the A.T.I. may be taken further away from the closed circuit coil and coupling between the two circuits obtained by a small coupling coil connected in series with the A.T.I. and sliding inside the closed circuit coil.

**"F.M." (Sydenham)** *has a coil* 4" × 3" *wound with No.* 18, *and asks* (1) *If it can be used as a secondary of a loose coupler.* (2) *For suitable dimensions of a primary for use with it.* (3) *What gauge wire for the primary.* (4) *Range of wavelengths the loose coupler would have.*

The coil suggested would be quite good for short wavelengths, but would not give above about 750 metres. A suitable primary to use with it would be 5" × 4" wound with the same size wire.

**"——" (Acton)** *hears Croydon telephony but cannot hear local short wave concerts. He asks why.*

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This is probably because your circuits were not tuned to a short enough wavelength, without the use of so little inductance that you obtained too little coupling. Try a series condenser in the aerial and a smaller closed circuit condenser.

**"H.H.R." (Bristol)** *asks for a circuit with dimensions of parts for best single valve receiver.*

See diagram (Fig. 3) for a very good circuit. Dimensions can be:—A.T.I., 8"× 6" of No. 24; aerial coupling coil, 4"× 3" of No. 24; closed circuit inductance, 7"× 5" of No. 26; reaction coil, 5"× 3" of No. 30; A.T.C., 0·002 mfd.; closed circuit capacity, 0·0005 mfd.; blocking condenser, 0·0015 mfd.; grid condenser, 0·0005 mfd.; leak, 3 megohms.

**"TRIUMPH" (Heckmondwike)** *sends diagram of set and asks* (1) *If the wiring can be improved.* (2) *If he should get good telephony.* (3) *Where to put a vernier condenser.* (4) *Why he can only get signals on 5 out of 8 slab coils in his set.*

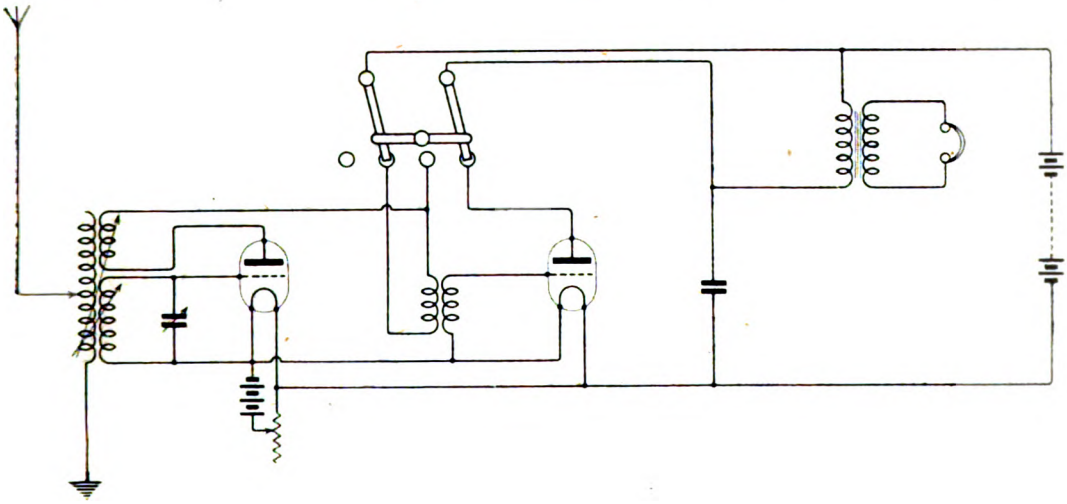

*Fig. 4.*

(1) Wiring is correct.

(2) Fair; but it would be better to have more H.F. and less L.F.

(3) In parallel with A.T.C. You should also have a condenser across primary of the first L.F. transformer.

(4) Coils are obviously defective, but we cannot say exactly how without examination. They may have a break in them, or more likely have a few turns shorted. The presence of shorted turns can be immediately detected if tuning is very flat on buzzer or similar signals.

**"R.J.S." (Catford)** *asks* (1) *For a diagram of a 2-valve set with a switch to cut out the H.F. amplifying valve.* (2) *If an L.F. magnifier is added, should it be transformer or resistance coupled.* (3) *If valves having a black appearance are hard or soft.* (4) *Approximate amount of amplication for one stage of H.F.*

(1) The circuit of the diagram (Fig. 4) complies with your requirements, but we do not particularly recommend any switching method.

(2) Almost immaterial. If you use transformer H.F. we should use transformer L.F., and similar for resistance coupling.

(3) Presence of black colour does not necessarily prove great hardness, but it is generally found in hard valves.

(4) Depends very largely on the type of circuit used. A current amplification of five times is very fair.

**"DORPITE" (Transvaal)** *refers to a condenser given on page 524, and asks* (1) *How the capacity is calculated.* (2) *For the capacity of another condenser.*

(1) The formula used is $C = \frac{N K A}{4 \pi d \times 900{,}000}$

where $N$ equals number of spaces between foils, in this case three, $K$ is the specific inductive capacity (mica = 6 approx.), $A$ is the area of the overlap of the plates, *i.e.*, 9 sq. centimetres, and $d$ = the thickness of the dielectric in centimetres, which is 0·004 × 2·54. This gives

$$C = \frac{3 \times 6 \times 9}{4 \times 3{\cdot}14 \times 004 \times 254 \times 900{,}000} = \frac{0{\cdot}0015}{\text{approx.}}$$

(2) Using exactly the same formula the capacity of this condenser is 0·0037 mfd.

**"E.P." (Sanderstead)** *refers to Fig. 2, page 584, of December 10th, and asks* (1) *If a single slide tuner could be used.* (2) *Which is the reaction condenser.* (3) *If a sample of wire sent is suitable for a lead-in.* (4) *If set is suitable for* PCGG.

(1) A single slide coil may be used for the A.T.I. if a reaction coil to slide inside the A.T.I. is provided.

(2) Strictly speaking no condenser in this set is a reaction condenser. Reaction is obtained by the coil across Condenser 3, which is better omitted. The coil need not have a slider.

(3) Yes.

(4) Just possible with very careful handling.

**"C.M." (Worthing)** *has three valves, a single layer inductance, two condensers and H.R. telephones, and asks for advice how to use them.*

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You have not enough apparatus for a 3-valve set, and you will find Telefunken valves, unless of the cylindrical plate type, very poor. We should advise you to try a circuit similar to Fig. 8, page 778, March 4th issue. We cannot give size of anode coil as you do not state dimensions of your present coil. 0·001 mfd. condenser should be across the telephones and 0·0005 mfd. condenser used for the grid. A 6-volt L.T. and a 30-volt H.T. battery will be required. The circuit will only just give **PCGG.**

(2) Either resistance or transformer coupled amplifiers may be used for telephony, but the resistance type are somewhat simpler to handle.

**"R.H." (Lewisham)** *asks* (1) *If the set given on page 156, May 28th issue, is suitable for C.W., spark or telephony.* (2) *What weights of wire will be required.* (3) *Gauge and suitability of sample of wire.*

(1) Yes.

(2) For A.T.I., 12 ozs. of No. 24, and for reaction coil, 3 ozs. of No. 28

(3) No 30 wire, which may be used for the reaction coil if desired.

If this is done, it will probably be best to rewind the coupling coil with finer wire.

(2) Yes.

(3) Method "B" is correct.

**"Q.T.C." (Dovercourt)** *asks* (1) *How long an "R" valve should last.* (2) *If it is normal to receive* **BGL** *on 1,000 metres.* (3) *Wavelength range of a certain set of basket coils.* (4) *Why signals are only received on a single valve set when it is howling.*

(1) Valve filaments more often break than wear out. They are particularly liable to break if roughly handled immediately after switching off. With careful handling a valve should burn 1,000 hours at least.

(2) This station can be received on a number of wavelengths owing to harmonics which it emits.

(3) We have no information about these coils. The makers should be able to give you the information.

(4) We are unable to say without detailed examination of the set. The result may be due to a too large reaction coil; to a faulty grid condenser or to the absence of a condenser across the telephones.

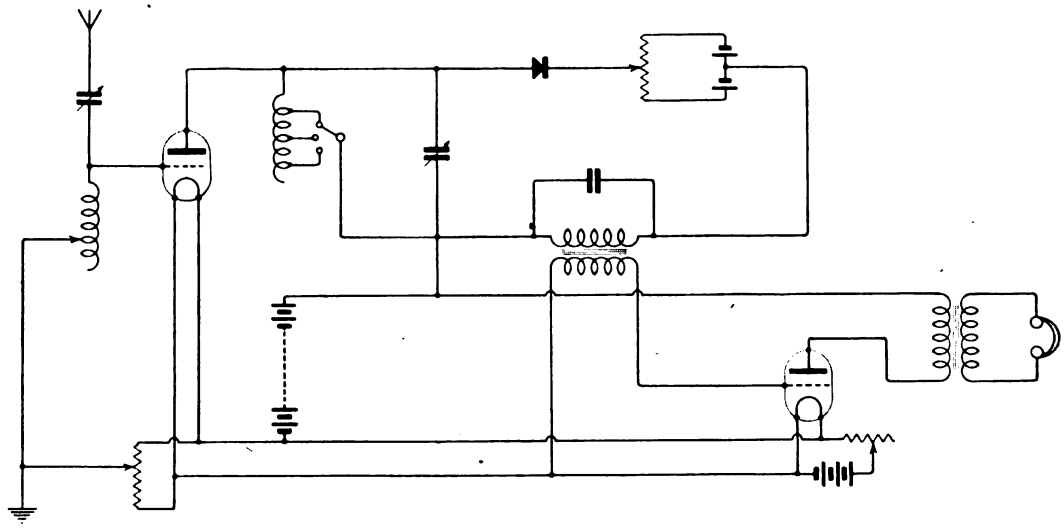

*Fig. 5.*

**"J.D." (London)** *wishes to add a note magnifier to the valve and crystal set described in April, 1920, using common L.T. and H.T. batteries.*

See diagram (Fig. 5). We regret we are unable to give you the exact differences between various of the Mark III and Mark IV amplifiers, but any of them should be suitable for use with this set.

**"H.H." (Morfa-Mevin)** *is adding a valve to a Marconi Type 16 receiver, and asks* (1) *If the coupling coil is sufficient inductance for a reaction coil.* (2) *If crystal potentiometer is suitable as grid potentiometer.* (3) *Which of two ways of connecting the aerial is the better.*

(1) This winding will be satisfactory, but owing to the smallness of the P.M.G. aerial it will be desirable to add a loading coil to the A.T.I. to get up to the maximum range of the closed circuit.

**"E.R." (Wimbledon)** *asks questions about a crystal set.*

(1) The crystal shown is wrongly connected. It should be between the condenser, as at present connected, and the potentiometer slider.

(2) For the reception of C.W. on crystal sets, see an article in the January 21st issue, but none of the methods of attacking this problem are very satisfactory.

(3) You will not get **PCGG** on this or any other crystal set.

**"K.B.S." (Campbeltown)** *asks* (1) *For size of formers for 3,000 metres.* (2) *If the reaction coil should slide in and out of the A.T.I.* (3) *For a suitable filament battery, other than accumulators;* (4) *For criticism of circuit.*

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(1) With 0·0005 mfd. in parallel with the A.T.I., this should be 5″ × 8″ of No. 24. The reaction coil 4″ × 4″ of No. 32.

(2) Yes; or the reaction coil may be wound on a spherical former revolving inside the A.T.I.

(3) The only alternative to accumulators is dry cells, which, if used, should be of very large size, say the Siemens' "M" size, which will give enough current for one valve for short periods. The use of dry cells would be very expensive.

(4) The circuit is all right. There is no simple switch of the type you desire. Such switches are made, but are very expensive. It might be possible to link your two switches together, but we think it hardly worth while as it is quite simple to interchange coils when required without any switching.

**"P.T.W." (Crofton Park).**—The connections of your set are incorrect. Rearrange as Fig. 3, page 585, December 10th issue. Do not use iron wire in the aerial. Unless you increase the A.T.I. the maximum wavelength will be about 1,500 metres. An indoor aerial is useless for a crystal set.

**"HOPEFUL" (Blackheath)** *asks how to add a valve to a Mark III tuner.*

An article on the conversion of this tuner for valve work was published in the June 25th issue, which can be obtained from the Publishers.

**"J.A." (Derby)** *refers to answer to* **C.C.W. (Woolwich),** *January 7th, issue and asks* (1) *Weight of wire for coils.* (2) *If A.T.I. has slider or tappings.* (3) *Ditto for secondary coil.* (4) *Wavelength range.*

(1) 8 ozs. of No. 22 and 4 ozs. of No. 26.

(2) A slider would be best.

(3) Three tappings will be sufficient.

(4) Aerial circuit 2,500 metres, closed circuit 4,000 metres.

**"J.N." (Barnet)** *asks for construction of details of H.F. transformers.*

These transformers are wound to suit the wavelength required. For information see issues of October 15th and 29th, and November 12th, 1920. Adjustment of the windings to best value should be done experimentally as it is difficult to predict them at all accurately.

**"M.E.T." (Reading).**—If No. 26 wire were used an A.T.I. about 9″ in diameter would be required with a reaction coil of about half this size, but we strongly advise the use of honeycomb coils. The dead-end switch arrangement you suggest while looking well on paper is quite useless in practice owing to the great difficulty found in making all segments make good contact at once. It is much better to use entirely different coils for different parts of the range.

**"C.H." (Sudbury Hill)** *asks for the relative advantages of grid potentiometers and grid leaks.*

These are not alternative pieces of apparatus. Theoretically, when a grid condenser is used a grid potentiometer is almost useless, but a leak essential. In practice a leak is not always found to be essential owing to accidental leaks already existing. If a grid condenser is not used a leak is of no use, and then a potentiometer becomes very desirable, especially in sets of few valves in order to adjust the valves to the best working points in their characteristics. We should advise you to consult a book on valve theory, such as Bangay's.

**"A.S.W." (Sparkhill)** *refers to Valve Panel, September 17th issue, and Panel Tuner, September 3rd issue, and asks if they will go well together.*

There is no object in mounting these two panels side by side in a box as one is simply an experimental panel, while the other is a complete coupled tuner with a valve detector. If desired an additional valve may be added to the panel tuner to give high or low frequency amplification.

**"G.D.H." (Yeovil)** *has trouble with a single valve set in which signals periodically fade away.*

You do not give a diagram of your circuit, but it would appear that you have a broken grid circuit which causes the grid to become negatively charged stopping signals until sufficient negative potential is obtained for the grid to discharge itself, after which the process is repeated. If you are using a grid condenser the resistance of the leak may be too high. For 3-valve diagram, see Fig. 5, page 706, February 4th issue. For 2-valve 2-note magnifier, see May 28th and June 25th, 1920 issues.

**——— (Harringay)** (1) *Sends crystal set for criticism.* (2) *Asks how to safeguard against lightning.*

(1) Set is wrongly connected. See Fig. 5, page 642, January 7th issue, omitting the condenser C.1. Maximum wavelength, 1,500 metres. You should get ships and **2 MT** telephony on 700 metres. Tinned iron sheets are very bad for condenser vanes.

(2) Best protection against lightning is obtained by joining the earth and aerial leads when the set is not in use. More detailed information is required before we can reply to your final question.

**"HONEYSLAB" (Coventry)** *asks* (1) *Windings for 12 basket coils for 120 to 25,000 metres.* (2) *Capacity of condenser.* (3) *If basket coils wound in and out of slots cut regularly in a piece of cardboard are as good as coils wound on a spider which can be removed when the coil is finished.*

(1) Beyond the scope of these columns. The smallest coil might have about 30 turns with a mean diameter of 2″, and the maximum, say, 1,000 turns on a number of coils each of mean diameter of 4″. With a reasonably good condenser not more than six coils intermediate between these should be required.

(2) 0·0003 mfds.

(3) This method is satisfactory if the cardboard is well impregnated with wax or shellac, but not if it is allowed to get damp.

**"D.G.L." (Southborough)** *refers to Fig. 3, page 674, January 21st issue, and asks* (1) *If suitable for spark, C.W. and telephony.* (2) *Suitable windings for 5,000 metres.* (3) *Capacity of A.T.C.* (4) *Capacity of 0·0005 and 0·0001 mfd. condensers.*

(1) Yes.

(2) A.T.I., 6″ × 14″ wound with No. 26. Reaction coil, 5″ × 8″ of No. 30.

(3) 0·0003 to 0·0005 mfds.

(4) For 0·0005 mfds. four foils, two each side with overlap 2″ × 1″, if waxed paper is 0·005″ thick. For 0·001 mfds. four foils one side and three the other.

**"J.D.J." (Erith)** *asks if his three valve set will receive telephony if it has a reaction coil.*

It will probably receive it without a reaction coil but better still with one. We cannot give best size as you do not describe your windings.

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**"T. F." (Hull)** *referring to page 533, November 26th, asks for information about the impedance amplifier there described.* (2) *Asks for windings for A.T.I. and reaction coil suitable for 160 to 1,200 metres.* (3) *Asks for a design of an H.F. amplifying panel to be added to a detecting panel, if possible to be used with a simple throw-over switch.*

(1) We have no additional information about this set, but think it probable that it is similar to a resistance capacity amplifier with iron core chokes instead of the anode circuit resistances.

(2) A.T.I. 7" × 5" of No. 20, no condenser being necessary. Reaction coil 4" × 4" of No. 26.

(3) Without a diagram of your panel we cannot be certain that this can be done. If it is possible, the connections would be on the lines of the diagram (Fig. 6) which will show you how your panel should be rearranged if necessary. Switching in of the additional stage would need a complicated and expensive switch liable to give trouble in various ways, and is not recommended.

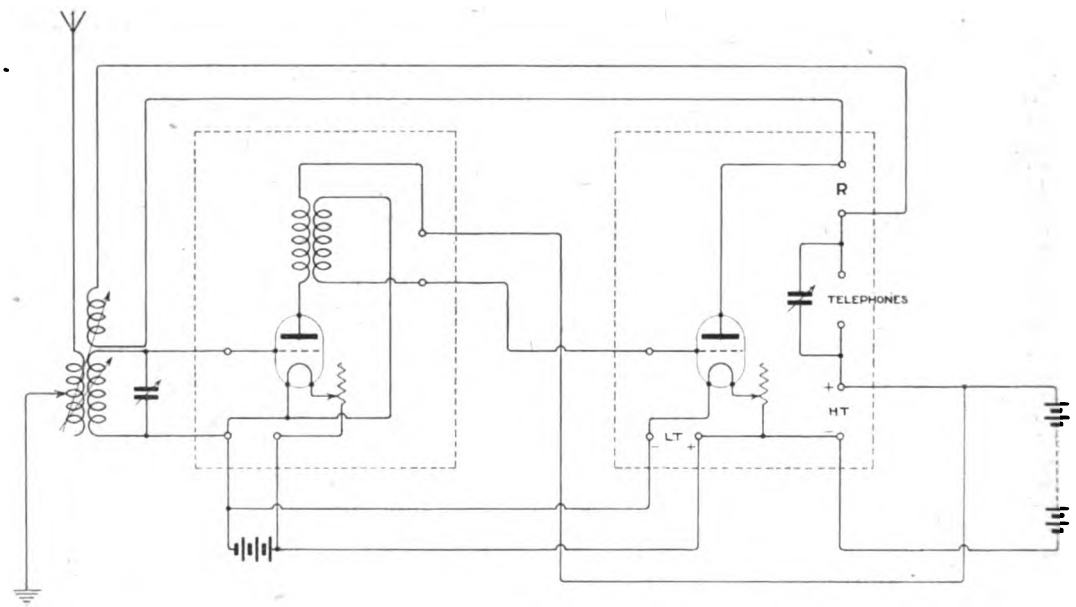


*Fig. 6*

**"AUDION" (Abercynon)** *asks* (1) *If a circuit sketched is satisfactory.* (2) *If 120 ohms telephones would be satisfactory with a telephone transformer.* (3) *What make of valve we recommend.*

(1) Yes, except that a condenser is required across the H.T. battery and telephones. (2) Yes.

(3) Any of the advertised makes are quite satisfactory. One of the type known as "French" would be satisfactory.

**"T.A.T." (East Acton)** *wishes to make an electrostatic receiver on the lines of that described in July and August issues. He asks* (1) *The best material to use.* (2) *Suitable polarising voltage.* (3) *If a gramophone motor would be suitable for the drive.*

(1) Many different forms of this apparatus have been tried, none of which are very satisfactory. The Rahbek form will give good results with a polished agate cylinder. This will be difficult to obtain and very expensive. On the whole, the oil dielectric form will probably suit your purpose best.

(2) For the Rahbek form the polarising E.M.F. should be about 200 volts; for the oil form it is not necessary.

(3) This spring would only be useful for experimenting on a small scale, as considerable force is required to drive these instruments.

**"P.S." (Ramsgate)** *sends a two-valve circuit with a resistance coupling and asks* (1) *For the value of the resistances.* (2) *Particulars for making them.* (3) *Whether the grid leak is necessary.*

(1) Anode resistance about 50,000 ohms, grid leak about 1 megohm.

(2) Waxed cardboard is unsuitable for making these resistances with; use ebonite or dry slate and rub in the pencil lead until the desired results are obtained.

(3) The grid leak is very necessary unless the grid condenser itself is very leaky.

## SHARE MARKET REPORT

Prices as we go to press, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 3 | 9 |
| ,, Preference .. .. | 2 | 0 | 0 |
| ,, Inter. Marine .. .. | 1 | 8 | 0 |
| ,, Canadian .. .. | | 8 | 3 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | | 14 | 6 |
| Preference .. .. .. .. | | 13 | 0 |

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THE
# WIRELESS WORLD
## AND RADIO REVIEW
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# Faults in Valve Circuits: Diagnosis and Cure

By G. P. KENDALL, B.Sc.

IT is probable that the characteristic which most clearly distinguishes the seasoned wireless man from the novice is the former's power of quick location of the faults which occur from time to time on amateur-made sets; it often seems quite miraculous to the beginner to see how an experienced friend will don the telephones, switch on, say "something wrong," and put his hand on the trouble in a few seconds. This kind of thing, of course, is not really done by means of second sight, but by the use of two things, the first and most important being a systematic method of testing the set circuit by circuit, and the second a wide experience which enables one to recognise the indications given in the telephones by particular types of faults.

I hope, in the lines which follow, to show how a suitable series of tests may be worked out for any simple type of set. I say *simple*, because it is usually the owner of such a set who needs assistance: the man who runs a six-valve set has generally become fairly expert at locating faults. There is, it is true, another type who buys or makes, say, a three-valve H.F. amplifier, sticks it on to a loose-coupled tuner, and expects to get the Dutch concert without previously finding out the subtle difference between inductance and capacity, and whether the latter is best measured in litres or pints. This type of amateur, however, does not command my sympathy, and is really too difficult a person to cater for within the limits of a W.W. article.

The following examples show typical series of tests for locating faults in various common receiving circuits, and I think the reader will have little difficulty in adapting them to his own particular set.

Since the method of testing to be described is based almost entirely upon indications in the telephones, the first thing to do is obviously to make certain that they are sound. (With a pair of reliable make, in daily use, it is fairly safe, however, to assume that they are O.K., and proceed with the next test.) Place the tags across *one* small dry cell. A loud click should be heard on making and breaking the circuit. No click in either earpiece indicates a disconnection in either windings or cords. Short circuit first one and then the other earpiece and test again. If the disconnection (hereinafter called a "dis.") is in one earpiece it will be located by this method, but if the tests still give no result it means a fault in either the cords or *both* telephones. Settle the point by replacing the cords with sound wires and test again. A click in one earpiece only when testing across a cell indicates a short-circuit in the *other*; or in the cords leading to it. Replace cords with temporary leads, as before.

Assuming that the telephones have been proved to be in order, we will now proceed to consider the testing of the actual receiver circuits.

### I.—SINGLE VALVE AUTODYNE CIRCUIT.

(1) Switch on L.T. If the valve does not light, the fault is in the circuit shown with a full line in Fig. 1. Examine valve filament. If apparently

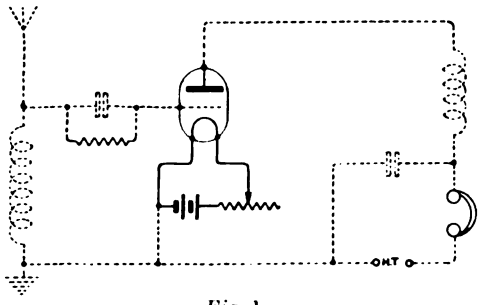


*Fig.* 1.

sound, pull the valve from its socket and open out the split pins carefully with a knife, to ensure their making contact in the socket. Replace valve and try again. If it still fails to light, replace it with another. If there is again no result, examine connections of L.T. circuit, especially the soldered ones on the valve socket.

(2) Switch on H.T. (with L.T. off). A good loud click should be heard in the telephones, as a result of a charge passing into the by-pass condenser C. No click indicates a dis. in the circuit shown with a full line in Fig. 2. A likely spot is the by-pass

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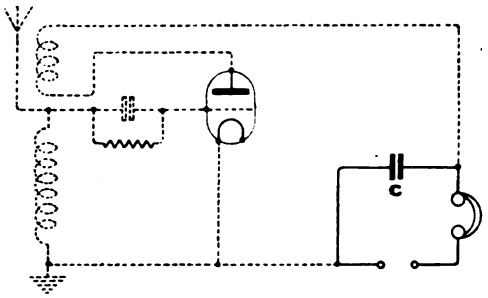


*Fig.* 2.

condenser itself. A very loud click followed by rushing and rattling noises indicates a short circuit, also very probably in the blocking condenser.

(3) With H.T. on switch L.T. on and off. A click at "on" and another louder one at "off" should be heard. No result means a dis. in the circuit shown with a full line in Fig. 3. Examine connections of reaction coil and open plate pin of valve. If this does not clear the fault change the valve.

(4) Switch on L.T. and H.T. and tighten reaction coupling until the set oscillates (or doesn't, as the case may be). If no oscillation results, reverse the connections of the plate coil (unless you are certain they are correct), and try again. No response indicates a fault in the circuits shown with a full line in Fig. 4.

(*a*) Variable condenser may be short circuiting (not very likely with one in ordinary continual use). Take it out of circuit and test by placing in series with telephones and a cell. With the capacity at minimum a *faint* click should be heard at make and break.

(*b*) A dis. between X and Y. This is best recognised by noting what sort of sound is audible in the telephones. If any interference from power or lighting mains is normally heard it will probably come in much louder when such a fault occurs. (Try it and see, because this is a most useful indication.) Check connections carefully, and if necessary test tuning coils for continuity with cell and telephones.

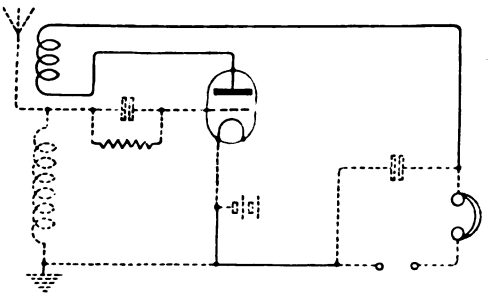

*Fig.* 3.

(*c*) Short circuit from X to Y. Unlikely and rather difficult to locate, there being no simple and universally applicable test.

(*d*) Dis. between X and grid of valve. This, again, produces much increased humming from A.C. mains, if any is usually heard. Likely places are pin of valve, soldered connection on the socket, and grid condenser.

Finally, if the set will receive spark signals but refuses to oscillate, although none of the above-mentioned faults appear to be present, it means in all probability that the filament accumulator is run down.

This completes the list of actual faults (the commoner ones, at least), but there remain three troubles which can hardly be classed as faults, since they do not cut out signals entirely, but nevertheless are capable of causing a great deal of wear and tear of the experimenter's temper. They are commonly known as "Overlap," "Howling," and "Artificial Thunderstorms."

*Overlap.*

This condition prevents many novices from getting satisfactory results, because they fail to recognise that anything is amiss with their sets. A circuit is said to be suffering from overlap when it is very difficult to adjust to the point required for the proper reception of telephony, that is, to a point just short of the beginning of self-oscillation. As the reaction coupling is tightened the set quite

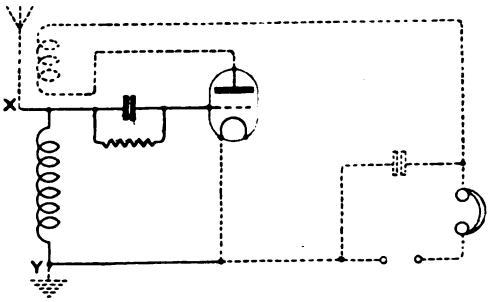


*Fig.* 4.

suddenly starts to oscillate, generally with a loud click. Then, to stop it, one has to weaken the coupling much beyond the point at which oscillation began, so that when it finally ceases the set is far from its most sensitive adjustment, and little can be heard. Even if, by patience and luck, one succeeds in getting the right coupling adjustment one's troubles are not over, for the set is then in a very unstable condition, and any strong signal or atmospheric will start it off oscillating. The usual causes are too much or too little plate voltage or filament current, or too low resistance in the grid leak.

*Howling.*

May be due to an unsuitable grid leak, too much plate voltage, too much wire on the reaction coil, etc. Results in shrieks and howls when the reaction coupling is tightened beyond a certain point. Not a very serious trouble, being chiefly trying to the nerves of the operator. Indeed, a certain tendency to howl when the reaction is too strong is rather desirable from one point of view; it would stop many amateurs from making a nuisance of themselves in their misguided efforts to receive telephony.

*Artificial Thunderstorms.*

The name indicates sufficiently clearly what the symptoms of this trouble are like. It is often

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very puzzling to the novice, because the possible causes are so numerous. These are some of the likeliest :—

(*a*) Bad or run-down cells in the H.T. battery. If the battery is composed of 4½ volt refills, test through with a flash-lamp bulb and cut out any cells which do not give a light. In the case of 15 volt units try cutting out each unit in turn until you find the one which is making the noise. The same tests will locate another possible cause, namely, a bad connection in the battery.

(*b*) A loose contact almost anywhere, but generally in the plate circuit. Test by striking the instrument table. If this results in a particularly heavy peal, look for loose wires, tighten terminals, see that switch contacts are clean, and so on. This test, by the way, is quite a useful one, and can be applied so as to locate loose contacts in various parts of the set. It is so popular with some experimenters that I am told that not merely do they wear their tables into holes, but that this is the true source of the emphatic style of some wireless lecturers !

(*c*) Defective grid leak. Cut it out and see if the noise stops.

(*d*) Charged rain falling on the aerial. This is by no means so rare as was thought in crystal days. Disconnect the aerial and note whether the noise continues.

## II.—Multi-Valve Circuits.

It will be seen from the foregoing that it is a fairly simple matter to work out a series of tests for any single-valve circuit. When a series is required for a receiver employing more than one valve, however, it is not quite so easy. The guiding principle in such a case should be to test each valve and its circuits separately, beginning with the valve whose plate circuit contains the telephones and finishing with the one which is connected to the tuned circuits. Testing by this method is greatly facilitated by the provision of separate H.T. and L.T. switches for each valve. The following examples are intended more as illustrations of the method than as an attempt to cover all the possible varieties of simple circuit :—

*A.—Rectifier and one note magnifier.*

(1) Test note magnifier filament circuit as before.

(2) Switch on H.T. Strong click should be heard in the telephones, as in the case of the rectifier circuit. (*Note.*—This test does not work without the condenser C, whose presence is desirable for this reason and because it often clarifies telephony considerably.) No click means a dis. in the part of Fig. 5 shown with a full line.

(3) With H.T. on, switch L.T. of the note magnifier on and off. Clicks indicate that the plate circuit is O.K.

On the completion of these tests it is generally safe to assume that the note magnifier is working satisfactorily, since faults in the grid circuit are somewhat unusual. If it is suspected that one is present, test for it by connecting a cell to the intervalve transformer primary. Loud clicks should be heard at make and break if the L.F. amplifying circuit is free from faults. The rectifier and its associated circuits can now be tested exactly as before.

*B.—One H.F. Amplifier, Rectifier.*

(1) Test rectifier circuits as given previously. (Nos. 1-3. Note also (4) *d.*)

(2) Test filament circuit of H.F. valve.

(3) With H.T. to both valves on and filament of rectifier alight, switch the H.F. valve filament on and off. Clicks indicate absence of faults in H.F. amplifier plate circuit.

(4) Test the tuned circuits and grid circuit of the H.F. valve as in Test (4) of the single valve series.

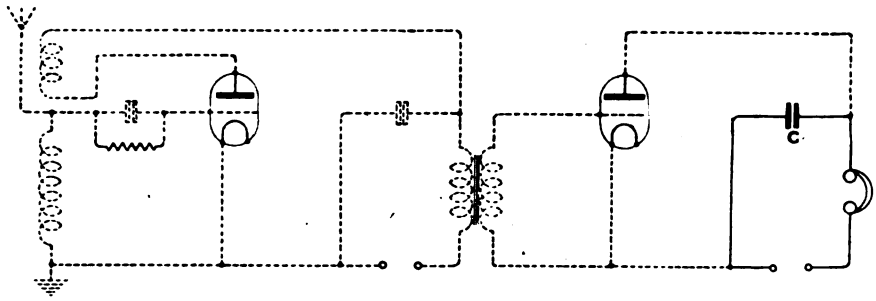


*Fig.* 5.

*C.—One H.F. Amplifier, Rectifier, one L.F. Amplifier.*

(1) Test the circuits of the L.F. valve as in *A*.

(2) With H.T. and L.T. switched on to the L.F. valve test the rectifier circuits as in *B* (1).

(3) With H.T. and L.T. switched on to both note magnifier and rectifier test the H.F. circuits as in *B* (3) and (4).

This completes the set of examples, since circuits employing more than three valves can hardly be classed as simple, while the other possible simple types of one, two, or three valve circuits may be tested in a very similar way to those dealt with ; I think the reader will have little difficulty in making the necessary modifications, and once they are made he will be in possession of a set of tests which will go far towards removing the feeling of helplessness which is apt to seize the novice as he sits and looks at a set which appears to be O.K., but which refuses to yield a sound in response to his efforts.

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# The Modern View of Electricity and the Three-Electrode Valve

By G. G. BLAKE, A.M.I.E.E., A.Inst.P.

(*Concluded from page* 73.)

WE will now see what practical use can be made of the information we have just gained, and at the same time try and picture what actually happens to the electrons in the valve, as the grid voltage is varied.

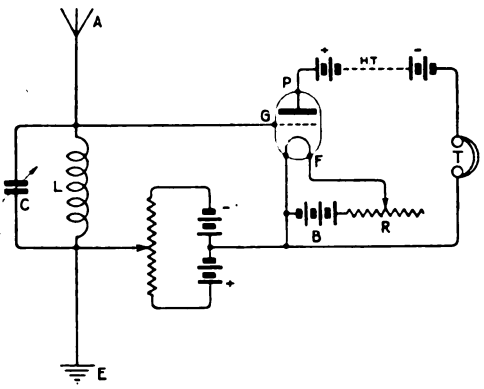


*Fig.* 6.

Fig. 6 shows a valve coupled up to an aerial circuit. For each spark at the distant transmitting station a train of waves reaches the receiving aerial, causing a high-frequency alternating current in the aerial tuning inductance, so that if our potentiometer is set at zero, the grid of the valve changes from positive to negative, say some 9 or 10 times with diminishing amplitude. If we have arranged for the valve to function at the centre of the straight portion of its curve, these fluctuations of grid voltage will produce exactly similar fluctuations in the plate current, having the same frequency but much greater amplitude, and the valve will be functioning as a high frequency amplifier. We shall, however, hear nothing in the telephones, as the amplified currents are at a frequency above audition (that is at radio frequency).

In order to hear the signals in a telephone, we should have to pass them through either a crystal, or other form of detector, working either at the top or bottom end of its curve, in order to rectify them.

Of course, if instead of connecting our grid to a circuit alternating at radio frequency, we connect it to a circuit alternating at audible frequency, we should obtain audio-frequency amplification or note magnification.

Fig. 7 indicates diagrammatically a mechanical illustration which I have devised to show the action of incoming oscillations upon the grid and plate current of a valve. These oscillations are represented by the movement of a cotton thread held in position by a frame (*see* fig. 7) which can be made to oscillate. The cotton rubs against a small disc representing the grid of valve, causing a spring, which represents the plate current, to oscillate also.

If the disc is on zero line, it will oscillate equally above and below it, see characteristic curve of valve at top of slide. If we render the grid more negative by a small weight, at every downward oscillation, obviously our plate current spring cannot move far; but at every upward or positive half oscillation it is free to move.

Note the characteristic curve on the right of Fig. 7.

Our valve is now functioning at the lower end of its characteristic curve.

If we imagine the top of the spring to represent the filament, and its bottom, the plate, and movements above zero to be negative, and below positive, the effects will be reversed and the device serves to illustrate a valve functioning at its upper bend, and a decrease in grid potential will make a decrease in the plate current, while an increase produces only very slight increase.

Let us once more consider the conditions in the bulb of our valve. When we are working at the lower end of its characteristic curve, the filament is emitting more electrons than the positive potential of the plate is able to neutralise, and a cloud of electrons congregate round the filament, forming a space charge, which for any particular filament heat, and plate voltage, remains constant. The plate continually draws off all the electrons it requires, which are being continually replenished at the same rate from the filament. If we impress an alternating current on the grid, during the positive half of each oscillation, the grid attracts, and is able to neutralise a fairly large number of electrons in the space charge, and so for the moment a larger quantity are able to leave the filament.

At the negative phase of its alternation, the negative space charge repels the electrons on the grid, and very little alternation in the plate current occurs.

If we arrange the valve to function at its upper bend, we have these effects exactly reversed.

The space charge is now almost removed by the positive plate voltage, and if we make our grid more positive, very little effect occurs, as there is practically no space charge to remove. If, however, we make the grid negative, it creates an artificial space charge, and shuts off a large part of the plate current.

It is obviously better to employ the lower end of the curve for reception, so that each oscillation gives an increase of plate current, than it is to use the upper bend where a large current is passing through the plate circuit and telephones all the while, except during the reception of signals. In the latter case, as the grid has to be positive, a wasteful grid current is likely to be flowing which has a damping effect on the oscillations.

When the valve is functioning at the lower end of its curve each train of oscillations will cause a slight pulse of increase in the plate current, through the telephones, and this rise and fall of current

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occurs once during each complete wave train, at an audible frequency, which can be heard.

On the left of Fig. 8 is a diagram of probably the most popular single valve circuit at present employed. On the right are the connections necessary in order to add one stage of note-magnification, working from the same high tension, and low tension batteries. We will at present confine our attention to the single valve receiver. The various parts of the apparatus are so well known, that I need not describe them.

oscillation, until the wave train dies out, so that a steady negative charge gradually builds up on the grid, which, as already explained, repels the electrons emitted from the filament, and so reduces the plate current. At the termination of each group of incoming oscillations, the charge in the grid leaks off through the grid leak, and the grid and plate current return to their normal potentials. This comparatively slow decrease and rise of current produces an audible note in the telephones.

It should be noted that in addition to this com-

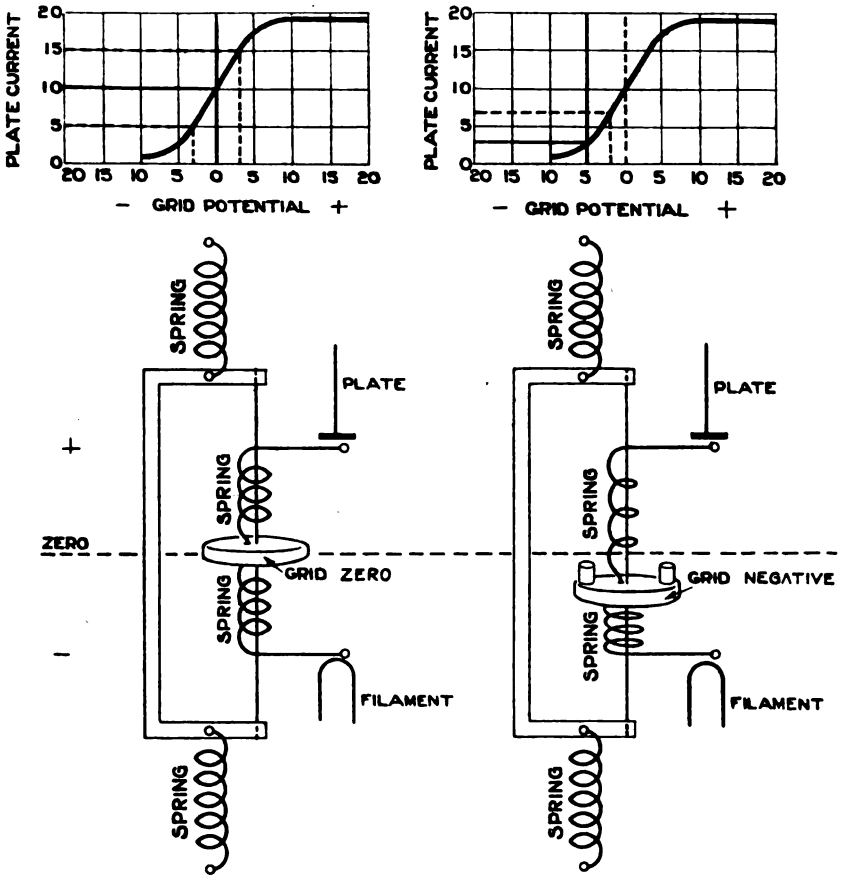


*Fig. 7.*

We will first examine the function of the grid condenser, and whilst so doing let us imagine that the reaction coil is removed so far from the aerial tuning inductance that it does not react.

The action of the grid condenser is somewhat as follows :—When the incoming oscillations tend to charge the grid negatively, no current flows from the filament to the grid ; but when the positive half of each oscillation passes into the grid, some of the electrons from the space charge pass into that plate of the condenser connected to the grid. This happens during the positive half of each

paratively slow building up of a negative grid potential, the grid potential also fluctuates at radio-frequency, which causes a radio-frequency rise and fall of the plate current through the phones ; this current is, however, inaudible. Its amplitude is increased if we place a condenser across the telephones and H.T. battery, to make a path of low impedance.

Again, referring to the Fig. 8, let us imagine that the reactance coil has been brought within range of the aerial tuning coil. It will now be seen that the received oscillations cause high

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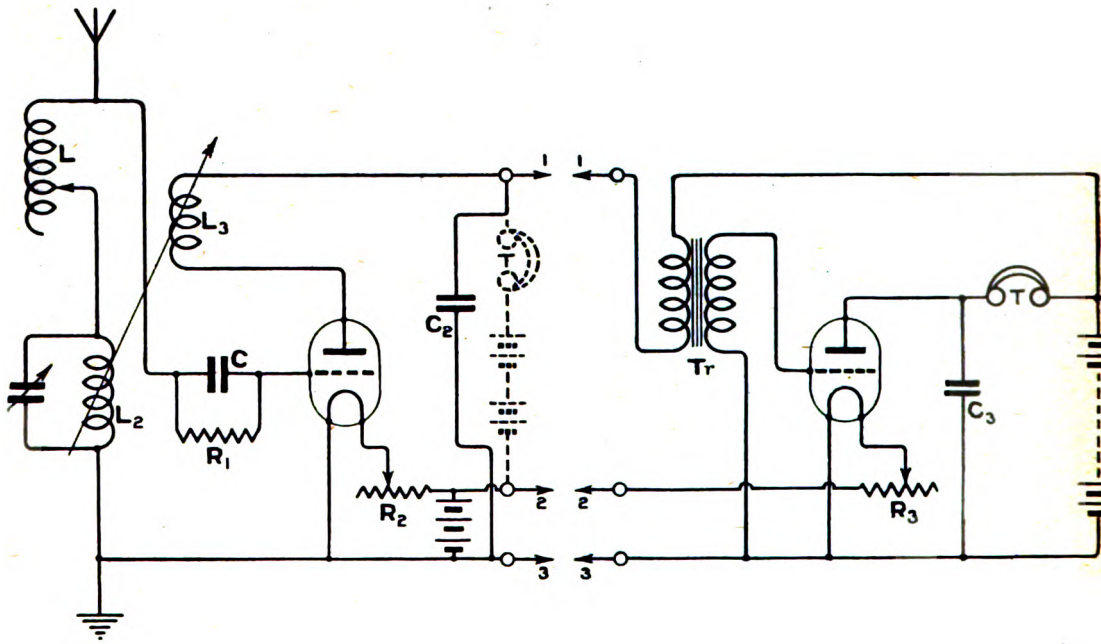


*Fig.* 8.

frequency fluctuations of grid potential (while the grid condenser is building up its negative charge). These are repeated in the plate circuit, and consequently they pass through the reactance, which by simple transformer action induces similar H.F. currents in the aerial tuning inductance, which amplify the oscillations already induced therein by the ether waves. (It should here be mentioned that it is absolutely essential to place the reactance the right way round, or it will wipe out the aerial circuit oscillations instead of amplifying them. Owing to the increase of the amplitude of the oscillations they will obviously persist longer in the receiving aerial; that is to say there will be more oscillations per wave train. Fig. 9 may make this clear.

If the coupling between the reactance and the aerial inductance is made very tight, the valve

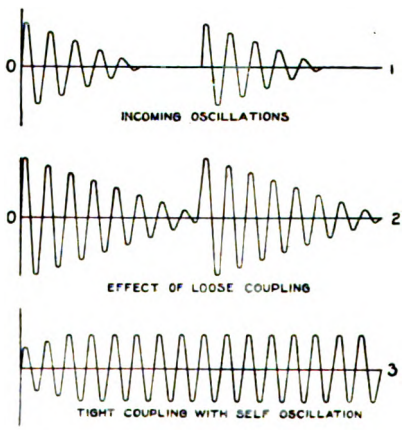


*Fig.* 9.

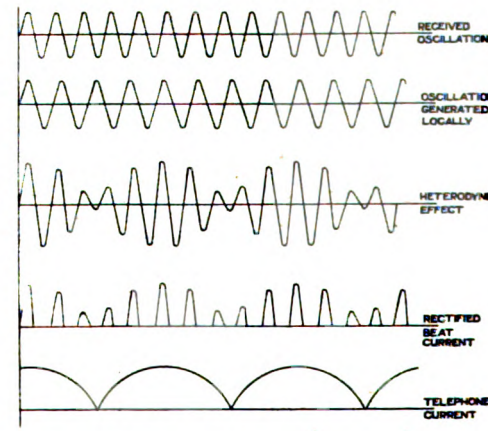


*Fig.* 10.

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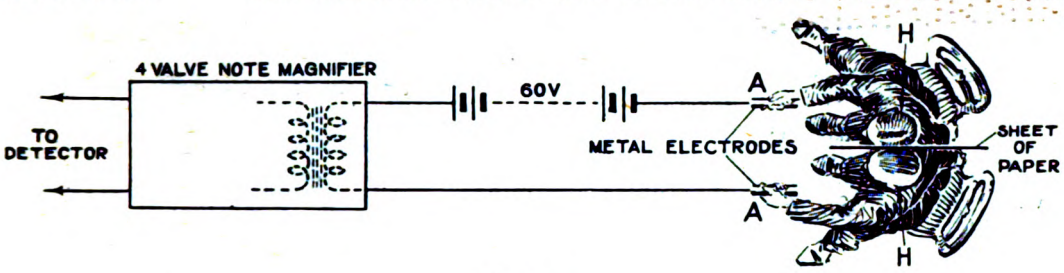


*Fig.* 11a.

oscillations never die out, and the valve is in a state of self-oscillation.

If we listen in a telephone while we vary the coupling between reactance and aerial inductance from zero to tight, we shall note an increase in the strength of signals as the reactance is increased; but at a certain point the signals lose their original note, and though they become much louder, their note becomes very harsh. This is because the valve

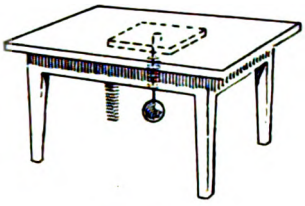

*Fig.* 11b.

has commenced to oscillate and is now generating oscillations. The harsh note is caused by beat effects between the two sets of oscillations, those rom the incoming waves, and those generated by he valve. This effect is known as heterodyning, and is made use of in receiving C.W. signals.

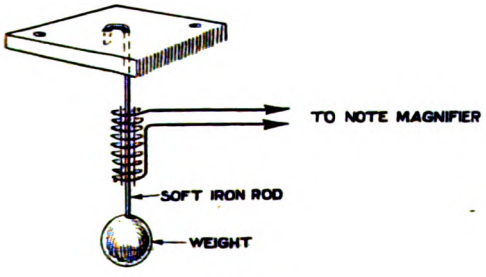


*Fig* 11c.

A valve is most sensitive in the reception of telephony when it is just on the point of generating oscillations.

For the reception of C.W. signals heterodyning affords the best method of reception. The waves themselves arrive at an inaudible frequency, and if we tune our receiving circuit so as to be just slightly out of tune with them, the beats produced by the two sets of oscillations will occur at an audible frequency.

(A mechanical lantern slide was shown at the meeting to illustrate the form of the wave motions illustrated in Fig. 9.)

In Fig. 10 are a number of graphs showing :—

(1) The received oscillations.

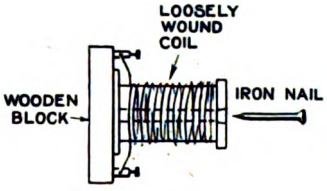


*Fig.* 11d.

(2) Local oscillations set up by valve.

(3) Heterodyne effect, and how, where the oscillations come into step, a greater amplitude is reached, due to reinforcement, and when out of phase, a reduction of amplitude occurs, due to interference. This graph is not quite correct as it does not show the change of phase which occurs.

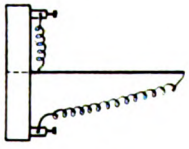

*Fig.* 11e.

(4) Shows the rectified unidirectional current.

(5) The rise and fall in plate current, which operates the telephones.

I will now give a brief description of the note-magnifier shown in the diagram, on the right-hand side of Fig. 8.

We must imagine the H.T. battery and telephones shown by dotted lines removed to the plate circuit of the second valve, and the three terminals, 1, 2 and 3 connected together.

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Every rectified pulse from valve No. 1 now alters the potential of the grid of valve No. 2, which faithfully reproduces every current change with increased amplitude in the plate circuit of the second valve.

This really concludes my lecture, but I have fitted up one or two telephone curiosities, which I have adapted to wireless uses, and which I thought would probably be of interest.

Figs. 11a to 11e show several rather novel methods of hearing wireless telephony and signals.

(1) If two persons hold a handle each, and are connected in series with the secondary of the output transformer of a 4-valve note-magnifier and a small H.T. battery, and place a sheet of thin paper between their heads as shown, they can both of them quite easily hear signals or speech. I have received music by this method at my station.

(2) If a person holds his hand on one side of a sheet of paper placed against the ear of another, the speech is heard by the listener. This effect is undoubtedly electrostatic.

(3) The paper can be dispensed with if the hand wears a thin leather glove.

(4) The voltage used is sufficient to overcome the resistance of a circuit consisting of several persons holding hands interposed between the two listeners and each of the handles, with very little diminution of signal strength.

(5) Another variation is for, say, three people to listen at once, connected up in cascade as follows:—No. 1 holds one handle from the note magnifier and places his free hand against a sheet of paper over No. 2's ear; No. 2 places one hand against a paper over the ear of No. 3, who holds the other handle from the note magnifier.

(These experiments were shown at the meeting.)

I have arranged another experiment based on Ader's telephone. Below the top of this table there is a light weight, suspended by a thin soft iron rod. A small bobbin wound with fine wire to the same resistance as the secondary of the transformer of the note magnifier, fits loosely round this rod, and is connected to the output transformer from the note-magnifier. The signals cause slight changes in the length of the iron, due to magnetisation, and any number of people who place one ear against the table are able to hear the signals. Ader's telephone, which led me to think of this experiment, is shown on the diagram, also two other very crude forms of telephone, which may be of interest.

(1) Very weak reproduction can be obtained with a loosely wound bobbin, in which is placed an iron core. (2) A straight length of soft iron wire, fastened at one end in a block of wood, will just allow sounds to be extremely weakly detected when connected as shown.

In conclusion, I wish to thank Mr. Pickering, my assistant, for the great help he has rendered me in the preparation of this lecture, also Mr. Hope-Jones, who very kindly prepared the two mechanical slides in a great hurry at the last moment.

## DISCUSSION.

**The President.**

This very interesting lecture is now open for discussion.

**Mr. P. R. Coursey.**

I am sure all present this evening must have been very interested to hear Mr. Blake's description on the action of the valve. When we use valve circuits every day we do so, perhaps, without thinking what happens in the valve itself. It is therefore very enlightening to spend a moment to reconsider where we are and to consider what is happening inside the instruments we are using.

The mechanical analogy of the valve using a frame and the threads and springs which he described is extremely interesting, and I think perhaps some day he ought to be persuaded to rig up the apparatus in this Lecture Hall and give a demonstration to the Society. I am sure we should all be interested to see it, and feel that it could be used to show up many of the phenomena which occur in the valve, with very slight modifications made in it.

He referred in his lecture to the voltage amplification factor of the valve. He asked me, before the lecture, to give a description of a little instrument which I had made up the other day for measuring in a simple way that voltage factor without any complicated apparatus. If I may just describe it on the blackboard it will perhaps be clearer. As Mr. Blake has already told us this evening, the voltage amplification factor of the valve is the ratio of the change which must be made in the high tension battery in order to keep the anode current constant to the corresponding change which is made in the grid voltage. Hence, if we rig up a potentiometer across some suitable source of A.C. and arrange it so that we can supply by it a small fraction of the total voltage on to the grid circuit of the valve, and the remainder of the applied A.C. to the plate circuit of the valve, it will be found possible, by moving that slider along, to discover a position on the potentiometer where there will be no sounds in the telephones in the plate circuit, due to this source of audible frequency A.C. This means that at any given instant we are applying, say, a negative voltage to the grid and in opposite phase we are supplying a positive voltage to the plate. When there is no sound in the telephones there must be no change in plate current, and therefore the ratio of the voltages applied to the two circuits must be the voltage amplification of the valve. The ratio of these two voltages is the ratio of the resistance $r_a$ in the plate circuit to the resistance $r_g$ in the grid. Hence, $r_a r_g$ is the voltage amplification factor of the valve. That is a very simple experiment to carry out and it is one, moreover, that can be carried out with simple apparatus which does not require the use of an expensive moving coil galvanometer, but merely a buzzer with transformer for the A.C. source, a potentiometer and a pair of telephones. When using an ordinary potentiometer, the readings are a bit rough, but are probably good enough for many practical purposes. I have had such an instrument made up but it was not possible to bring it here to-night, but perhaps on some other occasion it may be possible to show it in action.

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Simple measurements of that sort may be very useful in enlightening us as to what is happening in our valves when we use them under various conditions, and they are such as can be recommended to every experimenter as they require no complicated apparatus. I am sure all of us will wish to express our greatest thanks to Mr. Blake for giving us such an excellent lecture this evening and for showing so many interesting experiments.

**Mr. Maurice Child.**

I endorse Mr. Coursey's remarks on the very interesting exhibitions that we have had to-night, and also the subject matter of the lecture. One experiment which interests me very much is that in which the lecturer showed the electroscope and the lantern. It struck me as possible, in future, to introduce this into ordinary wireless methods and that possibly this scheme may be worked on a larger scale over short distances for signalling purposes.

I am afraid I cannot add anything of interest to what Mr. Coursey has said. We ought to be very grateful, indeed, to Mr. Blake that at such short notice he has given us such excellent demonstrations and experiments.

**The President.**

Mr. Blake is ready to show the ultra-violet experiment now, and I am sure he will reply later to the remarks that have been made.

**Mr. G. G. Blake.**

I think, Mr. President, there is practically nothing to reply to but with regard to this, with reference to the ultra-violet rays, I should like to show it now. This experiment is, perhaps, rather away from the point of the lecture so it is just as well not to show it until now.

(A demonstration showing some of the properties of ultra-violet light was then given.)

**The President.**

Mr. Blake has covered a very large field this evening in theory of atoms and structure of matter in its relation to wireless telegraphy, and I think we ought to give him our thanks for filling up the gap at such short notice. What he would have done if he had had a month's notice I do not know. I think it was an interesting and most instructive evening, and any of those interested in valves and their characteristics will appreciate the practical way he has explained it. I think I have nothing I can add of interest, but I will ask you to give a hearty vote of thanks for his very excellent and interesting lecture.

# Air Ministry Receiving Station

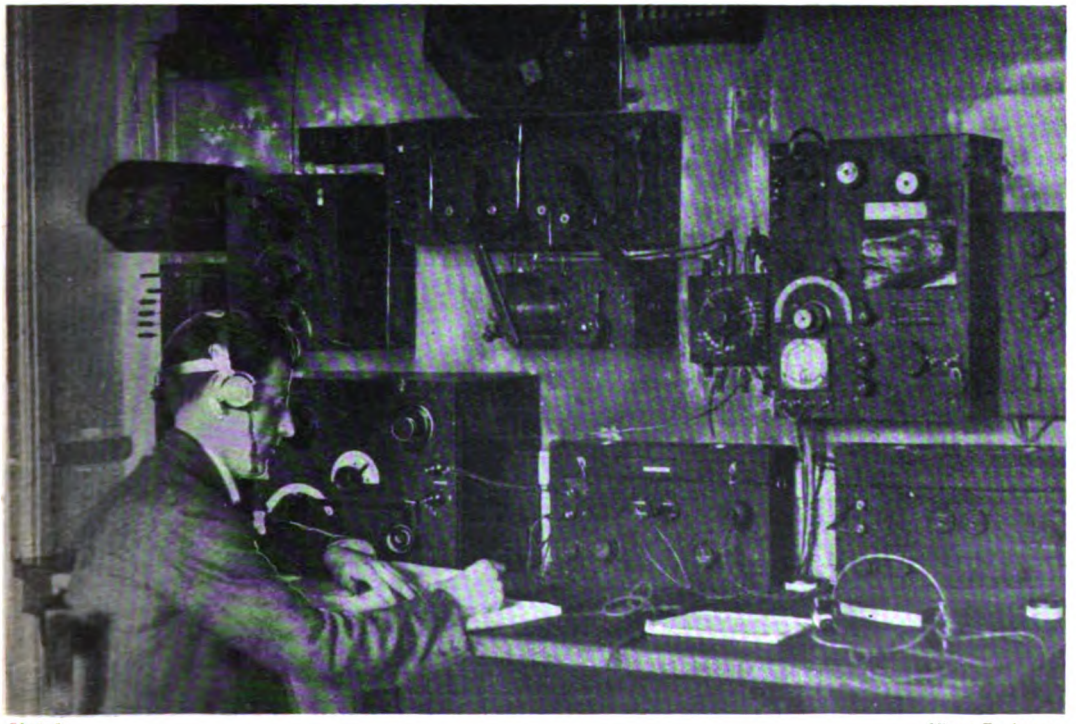

*Photo.]* *[Press Exclusives.*

***The above is a photograph of a receiving station at the Air Ministry.*** *Here weather reports are received and from the data thus collected meteorological forecasts are prepared. Such weather forecasts are available to farmers and others in this country who subscribe to the service.*

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# Notes on the Design of Radio Frequency Intervalve Amplifier Transformers using Iron Cores

By A. S. BLATTERMAN, B.Sc., E.E.

(*Concluded from p. 84.*)

**Example of Design and Experimental Checking of Theory.**

As an example of application of the formulæ that have been arrived at will now be given the calculations on a transformer constructed by the author. The theoretical results were checked experimentally with good agreement as is shown below.

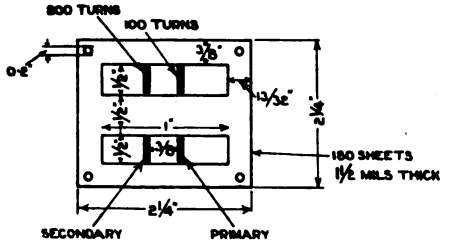


*Fig.* 15.

The core plates of the transformer in question are 1½ mils thick and have the other dimensions shown in Fig. 15. This particular transformer had no air gap $\delta l$.

The primary and secondary coils were made up in pancake units, 100 turns per unit, one unit for primary and two for the secondary. The primary and secondary are spaced ⅛ in. apart.

For the calculation of leakage flux it will be assumed that the central and side core legs are of equal size and round instead of square. The radius $R$ is taken at ¼ in. The cross section of the iron $A$ is 0·87 sq. cm. The mean length of magnetic circuit $l$ is 11·42 cm. Therefore

$$\sigma = \frac{b}{R} = 2$$

$$l = 11{\cdot}42 \text{ cm.}$$

$$A = 0{\cdot}87 \text{ sq. cm.}$$

$$\delta l = 0$$

$$\frac{l}{A} = 13{\cdot}14$$

from (16)

$$a = \frac{4\pi t}{3} \times \frac{\frac{l}{\mu A} + \frac{\delta l}{A}}{\log \frac{2}{2 + \sigma - \sqrt{b^2 + 4\sigma}}} = \left\{ \frac{42}{\mu} + 3{\cdot}68\ \delta l \right\} t$$

This is a general expression for "$a$" for all transformers using the core stamping shown in Fig. 15, both with and without air gap and for different spacing "$t$" between primary and secondary. The permeability $\mu$ depends upon frequency, as has already been pointed out. The last equation can therefore be more conveniently put into the following form where (32) and (33) are used for $\mu$.

$$a = \left\{ \frac{13{\cdot}9}{10^5} f^{0{\cdot}6} + 3{\cdot}68\ \delta l \right\} t \quad \text{for } f \text{ above } 200{,}000 \text{ cycles} \quad . \quad . \quad (34)$$

$$a = \left\{ \frac{16{\cdot}2}{10^4} f^{0{\cdot}4} + 3{\cdot}68\ \frac{\delta}{l} \right\} t \quad \text{for } f \text{ below } 200{,}000 \text{ cycles} \quad . \quad . \quad (35)$$

In Fig. 16 are shown values of $a$ for different frequencies and different air gaps calculated from formulæ (34) and (35) with $t$ equal to 1 cm. For values other than 1 cm the ordinates of the curves of Fig. 16 are to be multiplied directly by $t$.

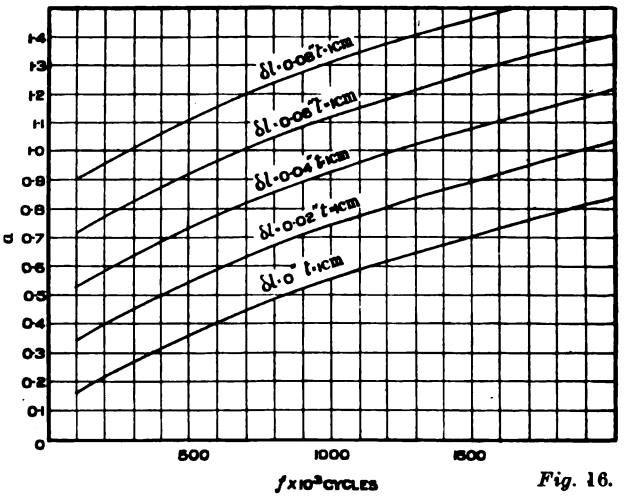


*Fig.* 16.

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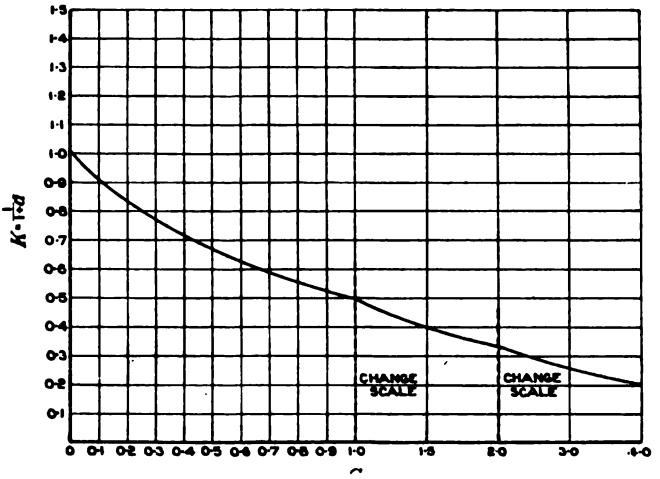


*Fig.* 17.

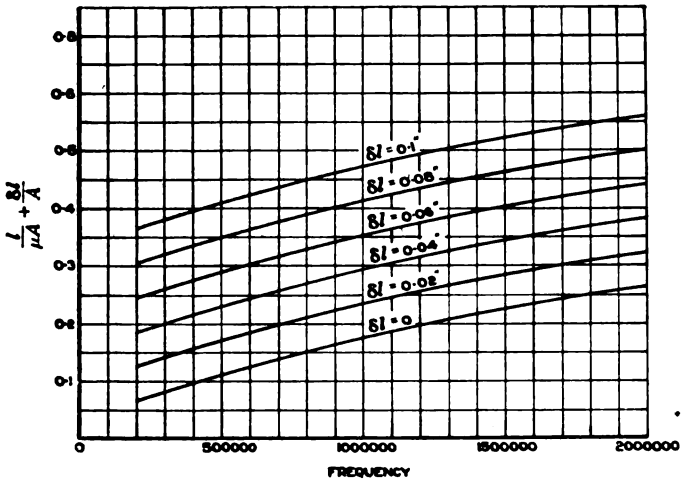


*Fig.* 18.

Similarly in Fig. 17 are shown curves of the coefficient of coupling, $K = 1/(1 + a)$, for different values of $a$; and for further convenience in design the quantity

$$\frac{l}{\mu A} + \frac{\delta l}{A}$$

found in the expressions (17) and (18) for inductance is plotted in Fig. 18 for different frequencies and values of air gap $\delta l$. With the help of these charts the inductance of a winding may be readily computed for any set of conditions relative to air gap, turns, and frequency from the formula

$$L = \frac{4\pi^2 N^2}{10^9} \cdot \frac{1}{JU} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (36)$$

wherein

$$J = \frac{l}{\mu A} + \frac{\delta l}{A} \quad \text{reading from Fig. 18}$$

$$U = \frac{1}{1 + a} = K \quad \text{reading from Fig. 17}$$



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In the present case, where $\delta l = 0$ and $t = \frac{3}{8}'' = 0{\cdot}953$ cm, the calculation gives the results shown in Figs. 19 and 20, $L_1$ depending upon the frequency according to curve A (Fig. 19) and $L_2$ according to curve A (Fig. 20).

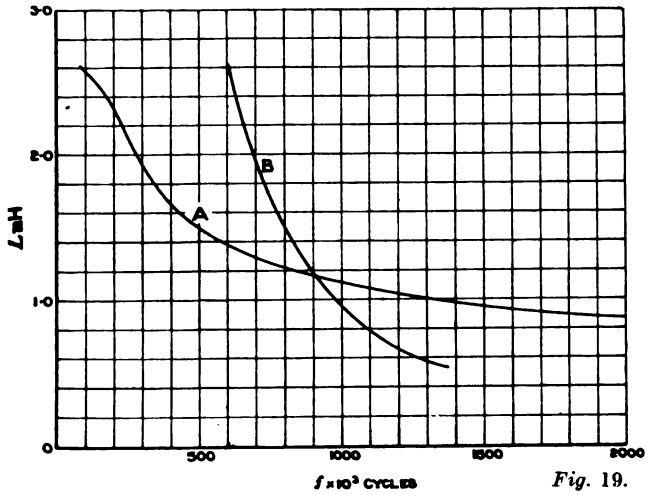


*Fig.* 19.

Proceeding now upon the supposition that the load on the transformer is a detector tube of the VT-1 type, we have for the secondary capacity $C_2$, as previously stated,

$$C_2 = C_g + C_m$$
$$= 15 + 13 = 28\ \mu\mu F$$

The primary capacity $C_1$ is

$$C_1 = C_p + C_m$$
$$= 13 + 13 = 26\ \mu\mu F$$

Curves B in Figs. 19 and 20 show the inductances required for different frequencies with the above capacities, and as is elsewhere explained the intersections of curves A and B in these figures determine the natural oscillation frequencies $f_1$ and $f_2$ of the primary and secondary circuits. Thus, the natural frequency of the primary is seen to be $f_1 = 900{,}000$ and the secondary is $f_2 = 360{,}000$.

From Figs. 16 and 17 we get the variation of $K$ with frequency set out in Table I. :—

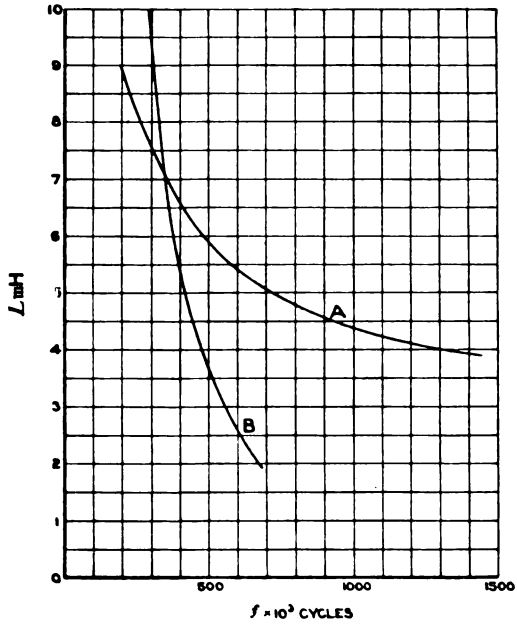


*Fig.* 20.

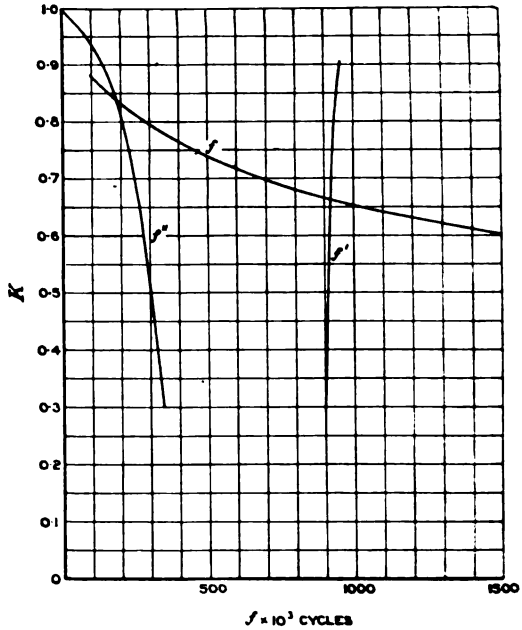


*Fig.* 21.

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These values are plotted in curve *f* of Fig. 21.

Formulæ (30) and (31) give the two curves of *f'* and *f''* (Fig. 21) showing the interdependence of coupling frequencies and *K*. The intersection of these curves with curve *f* give the two resonant humps

Table I.

| *f* | *K* |
|---|---|
| 200,000 | 0·833 |
| 400,000 | 0·77 |
| 700,000 | 0·70 |
| 1,100,000 | 0·64 |
| 1,500,000 | 0·60 |

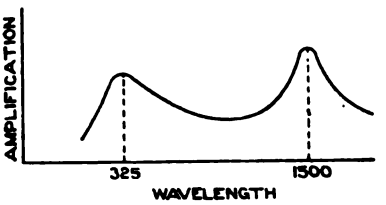


*Fig.* 22.

at which maximum amplification may be expected to occur as has been explained. These are seen to be 200,000 cycles and 925,000 cycles corresponding to 1,500 metres and 325 metres respectively. This Transformer might be expected, therefore, to work satisfactorily into a tube detector of the VT-1 type from perhaps 300 metres to 2,000 metres the amplification characteristic having peaks in the neighbourhood of 325m and 1,500m. and a depression between these values somewhat according to the rough curve of Fig. 22.

## Experimental Checking.

The theoretical results arrived at were checke l, firstly, by measuring the inductance of the primary of the transformer at different wavelengths and comparing these measured values with those calculated; and, secondly, by measuring the voltage amplification at different wavelengths with a single stage of amplification and the transformer working into a VT-1 detector tube by means of the standard circuit used for such measurements at these laboratories.

Comparison of the inductance values is made in Table II.

Table II.

| Frequency. | *L* mH measured. | *L* mH calculated. |
|---|---|---|
| 100,000 | 2·7 | 2·6 |
| 150,000 | 2·65 | 2·49 |
| 200,000 | 2·6 | 2·35 |
| 300,000 | 2·15 | 1·94 |
| 400,000 | 1·9 | 1·68 |
| 500,000 | 1·55 | 1·48 |
| 750,000 | — | 1·25 |
| 1,000,000 | — | 1·12 |
| 2,000,000 | — | 0·87 |

This table shows that the calculated values do not differ from those measured by more than 5 per cent.

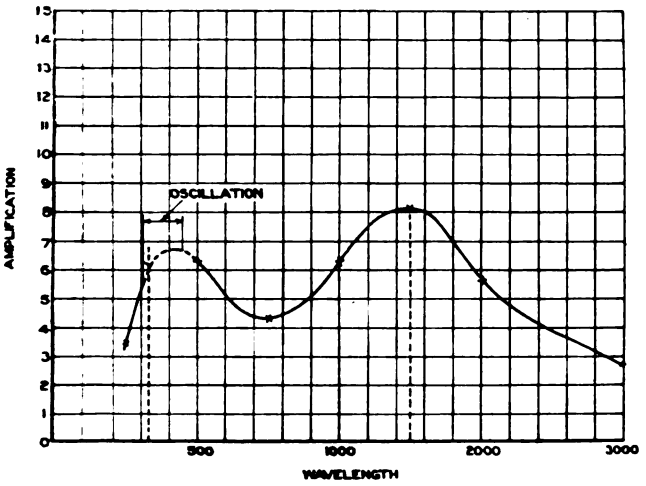


*Fig.* 23.

In Fig. 23 is shown the measured voltage amplification at different wavelengths. It is seen that one of the peaks comes at 1,500 metres, which agrees exactly with the calculations. With the apparatus used for making this measurement self-oscillations were produced between 450 and 300 metres, so that within this range it was not possible to trace the curve. Points were obtained, however, as shown, at 500 metres and 250 metres and the indications are that the other peak of the curve lies sufficiently near the calculated value of 325 metres for this latter figure to be accepted with confidence as locating, at least very closely, the position of the lower peak of the curve.

In conclusion the writer desires to mention that a very large number of experimental transformers and tests were made by his associate, Mr. Max C. Batsel, during the early part of the Signal Corps development, and much of the data thus obtained has proved invaluable in the practical construction of amplifiers.

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# RECOMMENDATIONS OF THE COMMITTEE of the WIRELESS SOCIETY OF LONDON

## Regarding the Regulations Governing Amateur Transmission

**Preamble.**

At the third Annual Conference of Affiliated Wireless Societies held on January 25th, 1922, a resolution was passed, arising out of item 5 of the Agenda, requesting the Wireless Society of London to open negotiations with the Post Office regarding the regulations now governing amateur transmission licences and also in regard to the substitution of some medium wavelength other than the present 1,000 metre wave for general amateur use—the object being to avoid interference by amateurs with aircraft traffic of which official complaint had been made. Speaking on the resolution, Captain Loring, R.N. (Radio Dept., G.P.O.), stated that the Post Office would be prepared to receive recommendations from the Wireless Society of London, and to give them every consideration.

The considered opinion of the Committee of the Wireless Society of London (hereafter referred to as "the Committee") is contained in the following recommendations:—

**1.** It is a condition of most amateur licences that transmission is permitted to a maximum of five other stations only. The Post Office is willing to make alterations from time to time in the particular five correspondents selected by any transmitting station, but frequent alterations must of necessity occasion considerable clerical work.

The regulation is irksome in the extreme, as amateurs are not always able to carry out their experiments with any of the five stations allotted to them, whereas they hear other suitable stations working, with whom they may not communicate, although such stations may be ready and willing to test with them.

The Committee is of the opinion that the present regulation serves no very useful purpose, and tends to limit research in the direction of obtaining maximum transmission distances with the power permitted—research as regards the design of transmitting and receiving apparatus.

The Committee therefore recommends:—

(*a*) That no restriction be imposed on amateur transmitting stations communicating with any other amateur station—provided always that no amateur transmitting station may, in any circumstances, make a "CQ", or any other general call.

Should it be considered impracticable to act on recommendation (*a*), the following alternative recommendation is put forward:—

(*b*) That amateur transmitting stations be permitted to communicate with any other amateur station within a defined area or radius. As to what the radius should be, the Committee, after careful practical investigation, is prepared to state that amateurs possessing good receiving apparatus have no difficulty in receiving transmissions from carefully designed transmitting stations using an input power of 10 watts at distances up to 60 or 70 miles in the case of telephony, and 150 miles and more for C.W. telegraphy. In the circumstances, it is hoped that, should a radius be imposed, it will not be too circumscribed.

Finally, the Committee, in the interests of research, desire to urge the Post Office to adopt recommendation (*a*) should it be in any way possible to do so.

**2.** The present regulations as regards hours of working provide that no station may transmit for more than two hours a day. Upon obtaining a licence the holder is permitted to select his own times, but once selected, he must adhere to them unless he gets them altered by the Post Office. In practice most amateurs have selected the same two evening hours, which makes it difficult to make proper experimental transmissions without experiencing jamming. From time to time most amateurs make alterations in their apparatus, involving adjustments and careful testing; in such circumstances it would be reasonable for them to seize an opportunity when others were not working and such a moment might well occur outside their allotted hours; it is not always practicable to make special application to the Post Office for an extension of hours on the occasion of each individual test. In fact, were continual applications of the sort to be made, considerable unnecessary clerical work and consequent expense would be occasioned to the Post Office. Considering the matter in all its aspects, the Committee is of the opinion that no very useful object is served by defining the exact hours between which stations are permitted to operate, and ventures to point out that, according to the wording of many of the licences, no contravention would take place were stations to transmit for an unbroken period of two hours at a stretch!—a most undesirable state of affairs. The Committee considers that a restriction should be imposed, governing the maximum period of *uninterrupted* transmission.

The Committee therefore recommends:—

(*a*) That amateur stations be authorised to transmit for an aggregate maximum time of two hours in each twenty-four, without mention of any specially defined two hours.

(*b*) That no uninterrupted transmission shall last more than, say, 10 minutes, followed by a period of not less than three minutes listening-in on the same wavelength as that used for transmission.

(*c*) That no transmission be commenced without previous listening in to ascertain whether the proposed transmission is likely to interfere with any other station (including amateur stations) which may be working.

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**3.** In principle, bearing in mind the complaints made by the Air Ministry that aircraft traffic has been seriously interfered with by amateurs who have been allotted the general wavelength of 1,000 metres for transmission, the Committee is of the opinion that it would be highly desirable for amateurs to be allotted some other medium wave in lieu of 1,000 metres. From information received it appears that aircraft land stations are obliged to use high amplification and very non-selective circuits in order that calls may not be missed from aircraft, all of which are not tuned sharply to 900 metres for transmission. In such circumstances, which it is recognised are unavoidable, it is not surprising that amateurs using 10 watts on 1,000 metres interfere occasionally with the reception of signals from aircraft. If such interference exists now, when most amateur work is done in the evenings, it may be expected to become worse when night and evening flying become more general. Should it be considered desirable to retain an amateur wave of the order of 1,000 metres, the Committee suggest that an alteration to 1,025 or 1,050 metres might minimise any danger of interference with aircraft.

However, it would be far preferable to give up the 1,000 metre wave altogether, and to substitute some wave of the order of 300 or 400 metres, preferably the latter. The following advantages of such a wavelength are cited, some of which are advantages from the point of view of the authorities, and nearly all from the point of view of the amateur.

(i) All danger of interference with aircraft entirely ceases, as also does the risk of interfering with Admiralty reception on 1,005 metres.

(ii) Transmission of telephony on 400 metres, using 10 watts, is so sharp that it can safely be stated that it will be absolutely inaudible, except on circuits tuned from 390 to 410 metres, and that it will be exceedingly weak except on sharply tuned receiving circuits.

(iii) From reports received from members of the Committee deputed to listen in, it would appear that no appreciable Government or commercial work is done on 400, 325, 375 or 425 metres.

(iv) The 400 metre wave is much better suited to the standard G.P.O. amateur aerial than 1,000 metres; such aerials will be found to be much better radiators on the shorter wave. This fact has been conclusively proved by experiment, and as it will enable the amateur to cover reasonable distances with the permitted 10 watts input, he will not have the temptation that is undoubtedly present on the 1,000 metre wave, to use excessive power in order to radiate a reasonable amount of energy so that he may be heard through the volume of spark jamming present on 1,000 metres.

(v) The design of transmitting apparatus is quite as simple on 400 as on 1,000 metres, and there should be little difficulty in altering existing apparatus to the proposed new wavelength.

(vi) The 400 metre wave is as easy to work on as 500 or 700 metres, and, on account of the vast amount of spark jamming on those wavelengths, they would be most undesirable.

As regards the short wave of 180 metres which is generally allotted to amateurs in addition to the 1,000 metre wave, it is not considered desirable to confine amateurs entirely to a short wave of that order, to the exclusion of an alternative longer wave. Topographical considerations do not permit all amateurs to erect an aerial of low inductance and capacity such as is necessary to secure efficiency of transmission and reception on waves of the order of 180 metres. Nevertheless, it is desirable that a short wave of this order should be available to amateurs in order to foster research and experiment in a direction which is certain to prove useful, bearing in mind that telephony on such waves can be carried out by a large number of stations within quite a narrow band of wavelengths without mutual interference. On account of this last cited fact, the Committee considers that the present 180 metre wave might well be extended and converted into permission to use the whole band of wavelengths from, say, 180 to 200 or 220 metres.

The Committee have accepted as a broad principle that the bulk of amateur stations will be licensed for two waves, one short and one medium. The Committee assumes that, as heretofore, the Post Office will always consider applications for other special wavelengths in those cases where really good and sufficient reasons can be shown.

The recommendations of the Committee, as regards wavelength, are therefore as follows: —

(*a*) That general use by amateurs of 1,000 metres should cease, and that a wavelength of 400 metres for C.W. and Telephony should be allocated in lieu. Should 400 metres not be practicable, that wavelengths of 375, 425 or 325 would, in the order named, be very nearly as suitable.

(*b*) That, in lieu of the present 180 metre wave allocated to amateurs, they be permitted to use at will the band of wavelengths from 180 to 200 or 220 metres for C.W., Telephony or Spark.

**Conclusion.**

The Committee is of the opinion that, should their recommendations be accepted, two great ends will be attained. The first is that the Services will have no further occasion to complain of amateur interference, and the second, that the amateur will be satisfied with the power permitted to him and will not have the great temptation that now presents itself to ignore sometimes the terms of his licence as regards excessive power, unauthorised wavelengths, times of working, and stations communicated with.

The Committee would remind the Post Office that they have been requested to assist in "maintaining reasonable discipline." They are prepared to do so whole-heartedly, but they would point out that their task will be lightened considerably if amateurs appreciate that the authorities desire to impose only such restrictions as may be really necessary, and show a willingness to withdraw others that may perhaps seem merely irksome.

Finally, the Committee believe that, through their Control Committee for the London area, and through sixty odd affiliated societies in the Provinces, they will really be able to assist the Post Office in seeing that the terms of licences are observed by their members, and in making these recommendations they undertake formally so to do.

(*Signed*) H. B. JACKSON,
Admiral of the Fleet,
*President.*

(*Signed*) H. LESLIE MCMICHAEL,
*Hon. Secretary.*

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# Russian Time Signals

## TRANSMISSIONS FROM PETROGRAD AND MOSCOW

DETAILS of the Wireless Time Signals sent by the stations of Petrograd and Moscow have been received from M. N. Dnieprovsky, Chief of the Time Service of the Pulkovo Observatory. As this information may be of service to astronomers and others interested in Wireless Time Signals, the substance of M. Dnieprovsky's communication and a few observations taken at Greenwich are embodied in this note.

In the first place it appears that Standard Time has been adopted in Russia, the time being two hours in advance of Greenwich. The time-determination is made at Pulkovo Observatory, which is connected by land-line with the wireless stations of Petrograd and Moscow. The programme of signals sent out is as follows, all times being expressed in Greenwich Mean Time (Civil), *i.e.*, reckoning from midnight :—

| Nature of Signal. | Time of Transmission (G.M.T.) | |
|---|---|---|
| | From Petrograd. | From Moscow. |
| Series of V's .. .. | 1900 to 1902 | 2155 to 2157 |
| Series of T's .. .. | 1902.20 to 1902.50 | 2157.20 to 2157.50 |
| Time Signal, consisting of three dashes each of one second duration with one second space. | 1903 | 2158 |
| Series of M's .. .. | 1903.20 to 1903.50 | 2158.20 to 2158.50 |
| Series of Time Signal dashes, as above. | 1904 | 2159 |
| Series of O's .. .. | 1904.20 to 1904.50 | 2159.20 to 2159.50 |
| Series of Time Signal dashes, as above. | 1905 | 2200 |

The corrections to the Time Signals are given at 1905.10 (Petrograd) and 2200.20 (Moscow).

### RHYTHMIC SIGNALS.

PETROGRAD.

1906 to 1913.49. Sixteen series of 22 dots; two series every minute from 0 to 19 seconds and 30 to 49 seconds. The spacing of the dots is 66 in 60 seconds of time, or 11 in 10 seconds.

MOSCOW.

Six series of 31 signals, commencing at 2202.30 each set being separated by the omission of 9 signals. This is followed by a set of 121 signals. This is followed by six series of 31 signals similar to the previous set. The interval between contiguous signals is 48 to 49 of 1 second.

The time of the first rhythmic signal is not communicated by wireless. In order to use interpolated instead of extrapolated clock errors the times will be published at intervals.

The Moscow Time Signals have been observed on a few occasions at Greenwich, but it was not understood when they were first taken that the figure telegraphed after the signals gave a correction to the time signal. The correction is shown on January 7th and January 9th :—

| Date. | Approx. Error of Signal. |
|---|---|
| | secs. |
| December 16 .. .. | 0.02 fast. |
| ,, 21 .. .. | 0.46 slow. |
| ,, 23 .. .. | 0.77 ,, |
| ,, 24 .. .. | 0.41 ,, |
| ,, 28 .. .. | 0.45 ,, |
| ,, 29 .. .. | 0.44 ,, |
| ,, 30 .. .. | 0.67 ,, |
| ,, 31 .. .. | 0.46 ,, |
| January 2 .. .. | 0.57 ,, |
| ,, 4 .. .. | 0.28 ,, |
| ,, 5 .. .. | 0.42 ,, |
| ,, 7 .. .. | 0.43—0.10 |
| ,, 9 .. .. | 0.60—0.30 |

With reference to the correction given for the Time Signal, the wording used in the description is to the effect that the whole seconds and tenth at which the clock sends the time signal are telegraphed. Three figures are given. For example, on January 7th these were 001, which is read as meaning the signal was sent 0.1 sec. late and correction appears to be given in that sense.

*(Communicated by Mr. W. Witt Burnham, Member I.R.E., by kind permission of Sir Frank Dyson, Astronomer Royal.)*

# Some Notes on the Edison Accumulator

THE principle of the Edison Accumulator is very different from the usual lead-acid type of battery, neither lead nor sulphuric acid being used in its composition. This type of accumulator is therefore free from sulphation, corrosion of terminals, buckling of plates, and similar familiar troubles.

The positive plate consists of a number of nickel-plated spirally wound perforated steel strips, forming tubes mounted in a nickel-plated steel grid. Each tube contains over 300 alternate layers of nickel hydroxide and very fine flake nickel, the whole being highly compressed. The tubes are bound with eight solid steel bands placed equidistantly, and in order to avoid the remotest chance of plate distortion, adjacent tubes are wound oppositely, *i.e.*, the right-hand wound tube is placed next to the left-hand wound tube and so on.

The negative plates consist of nickel-plated steel

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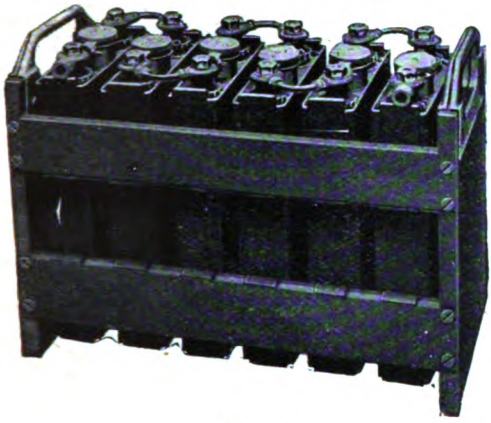

*Fig.* 1.

*A standard crate of Edison cells ready for use.*

grids which support a number of rectangular pockets made of perforated nickel steel ribbon. The pockets contain iron-oxide, and we may mention here that, practically speaking, the only chemical change which occurs with the Edison Accumulator is that on charge the oxygen leaves the negative element and joins with the positive element, while, on subsequent discharge most of the oxygen

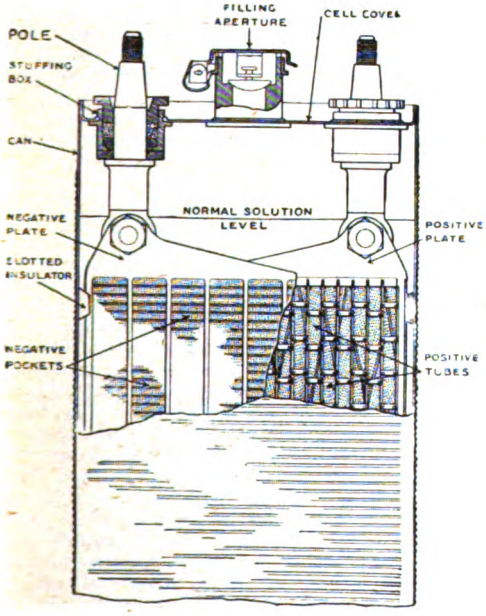


*Fig.* 2.

*Sectional view of an Edison cell.*

returns to the negative material. This chemical change is the nearest approach that has yet been reached (in accumulator construction) to being completely reversible. In other words the active material in the Edison cell is practically everlasting.

The negative plates are assembled in the manner indicated in Fig. 3, and the plates are separated from each other and the steel container by a special kind of hard rubber. As depicted in the illustration, the assembled elements of the Edison cell form a very neat and mechanically sound unit.

The container is constructed of sheet steel nickel plated. It is interesting to note that all steel used in the manufacture of the Edison Accumulator is nickel plated in an atmosphere of hydrogen, which process prevents the metal oxydising and therefore eliminates any possibility of the nickel peeling off the finished product.

An alkaline solution is used for the electrolyte, namely potassium hydrate which contains a small percentage of lithia.

Some advantages which are claimed for the Edison Accumulators are—

(1) Long life. They are guaranteed to give their full-rated capacity at the end of six years service. Their useful life is many times the guaranteed period.

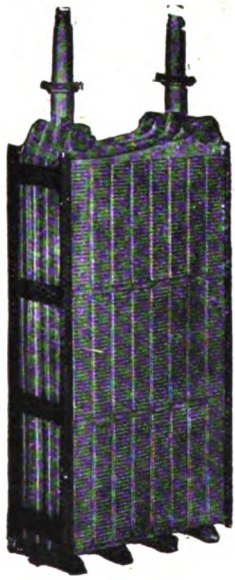

*Fig.* 3.

*An Edison cell assembled but removed from container.*

(2) Simple in operation. Only the addition of distilled water required to allow for evaporation.

(3) The Edison Accumulator can remain idle indefinitely in a charged or discharged condition without the slightest fear of deterioration. It can also be short-circuited with impunity, and even charging in the wrong direction will do it no permanent harm.

(4) No acid fumes are given off by the Edison battery, and it can therefore be placed in close proximity to delicate instruments without fear of damaging them.

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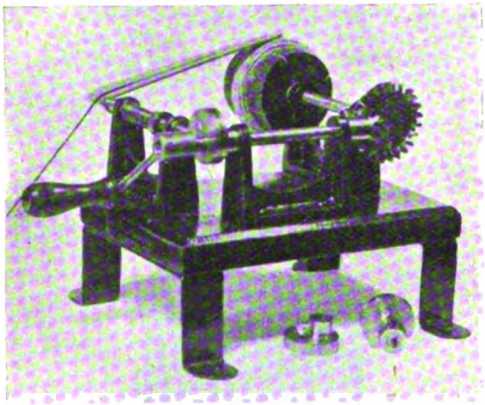
## A New Coil-Winding Machine

A MOST useful appliance in the equipment of the experimental station is an inductance winder capable of rapidly constructing flat tuning coils having reasonably low capacity between their turns and layers.

The machine shown has been designed for this purpose. It is supplied with interchangeable cams, making it suitable for winding coils of various widths and compensating for the difference in space taken by wires of different gauges and coverings. Skilfully handled, these cams are useful for spacing the turns when coils of specially low self-capacity are desired.



Although the manufacturer's instructions on the operation of the machine are a good guide and will lead one to the successful construction of very beautiful coils, the user is reminded that it is essential to keep a good pull on the wire while winding and to keep the oscillating rod pressed hard against the cam.

For uniformity, and in order to facilitate the collection of data, it is convenient to use only one gauge of wire. No. 26 D.S.C. wire wound with No. 1 cam will be found suitable for most purposes. Double silk and double cotton coverings are recommended on account of their elasticity, giving a little springiness between the layers. Intervalve oscillation transformers can be made by winding two wires simultaneously, taking care to keep a good tension and preventing the wires from crossing. No. 28 D.S.C. is best for this purpose and if green and white coverings are taken, the ends can be easily identified. Using cam No. 1, 130 turns of the handle produce a transformer suitable for wavelengths of 600 to 1,200 metres. A great advantage is that a number of transformers of identical value can be constructed for building a multi-valve high frequency amplifier. The outside ends are taken to the grids and plates.

For strength the coils can be impregnated with either wax or shellac, though if the latter is used care must be taken to bake the coils in order to dry out the interior. Of course, treatment of this kind increases the self-capacity.

## Experiments with "Loose Contact Telephone Receivers"

By Marius Thouvais.

WITH regard to Mr. Leslie Miller's paper, which was recently read before The Wireless Society of London and published in the December 24th issue of *The Wireless World*, I wish to point out experiments that were conducted in France before the war.

In 1914 a French amateur * had already discovered a curious phenomenon very similar to the one described in the paper referred to. The original apparatus with which experiments have been conducted differs very little from the one used by Mr. Leslie Miller. It consists simply of the usual telephone earpiece whose magnets and windings have been withdrawn; a small piece of galena is firmly soldered to a back-adjusting screw in order to be gently pressed against the usual metal diaphragm of the receiver. Of course, this adjusting screw is insulated from the metal case by an ebonite bush. A terminal is fixed to the metal ears and another one connected to the adjusting screw, as in Mr. Leslie Miller's receiver. Such an apparatus was simply used as an ordinary galena detector, without auxiliary current, and gave successful results. In experiments with a good amateur aerial about four miles away from Eiffel Tower spark signals were reproduced loud enough to be easily read several feet away from the set.

An article, entitled "Acoustical Reception on Crystal Detector without Telephone Receiver" (*Réception accoustique sur détecteur à cristaux sans écouteur téléphonique*) was published by Mr. Perret-Maisonneuve in the April 30th, 1914, issue of the French wireless review, "T.S.F. Revue mensuelle de Radiotélégraphie."

It may be quite interesting to point out that galena has been very successfully used without any auxiliary current.

## Exhibition at Hove, Brighton

UNDER the auspices of the Sussex Wireless Research and the Brighton Radio Societies a most successful exhibition of wireless apparatus lasting for three days—the first of its kind in the district—was held recently at the Hove Town Hall. Notable features of the proceedings were the lectures delivered by Capt. E. A. Hoghton, F.P.S.L., Associate I.R.E. (President Sussex Wireless Research Society), and the practical demonstrations on various types of apparatus by Capt. Hoghton, Messrs. E. Hughes, B.Sc., W. E. Dingle (President Brighton Radio Society), A. Blackburn and other gentlemen.

About 25 complete sets, dating from 1905 down to the latest types, were on view, together with loud speakers, a variety of wireless accessories and component parts, and an array of beautifully constructed bridges, galvanometers, milliamperemeters, and other measuring instruments. The amateur section included sets constructed by Messrs. Magnus Volk, W. E. Dingle, C. L. Fry, M. Foster and N. R. Phelp, the latter's pocket set attracting considerable attention. A complete set

* Mr. Perret-Maisonneuve.

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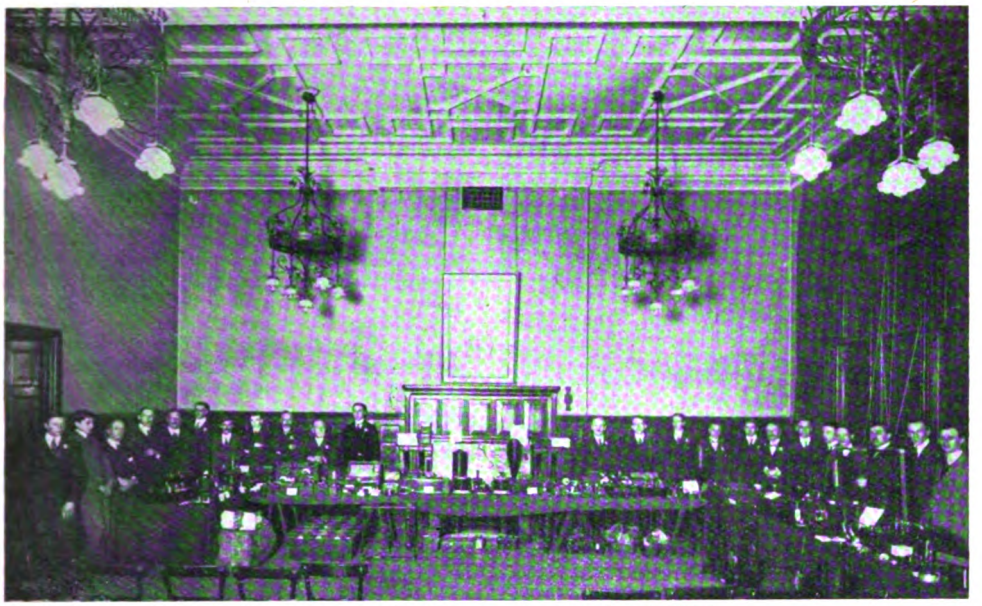

*The Town Hall on the occasion of the Exhibition.*

of their Unit System, kindly loaned by the Marconi Scientific Instrument Co., was much admired. Exhibits, which embraced such interesting items as a battleship coherer set, a 3-valve ship set, and two 6 and one 7-valve sets, would occupy far too much space, and it must suffice to remark that the apparatus as a whole was of a highly educative character.

The proceedings included lectures by Capt. Hoghton each evening.

The joint committee wish to place on record their warm appreciation of the courtesy and assistance rendered by the Hove Town Hall authorities, and to the Marconi Scientific Co. for apparatus loaned; to the Wireless Press, Ltd. for a splendid assortment of technical literature; Messrs. Siemens Bros. for high tension nd other batteries; the Brighton Municipal Technical College, Messrs. Isaacson and Brown, Messrs. Spicer and Co.; and the Zenith Manufacturing Co. for the loan of apparatus.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I will appreciate very much any information regarding a radiophone station in operation on March 28th at about (possibly before) 10.15 p.m. B.S.T.

During his conversation he called London, mentioned the name of a leading electrical engineering firm, his distance from London and his wavelength—360 metres.

The speech being very good, it may be of some interest to the gentleman operating the transmitter to learn that he was heard here.

Denmill Cottage, G. W. G. BENZIE.
Peterculter, Aberdeenshire.
*March 29th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Listening to the loud telephony transmitted from Paris last Tuesday, about 4 p.m. (single-valve), the speaker for a minute or more played fairly slowly up through three octaves of a piano, and then down again, putting in the semitones.

This afforded a very excellent means of adjusting the receiver to a maximum clarity of tone and loudness, the well-known steps of tones being brought to purity. This especially applies to the very high notes, say two to three octaves above C, which in a concert transmission are more difficult to hear, or to hear with purity.

The speech which followed was received with record audibility.

My object in writing is to bring this to your notice and consideration as to whether an adoption of this would assist amateurs in receiving other telephony, the "Hague," chiefly, which, though clear, does often become a task of adjustment, etc.

83, Argyle Street, THOMAS FORSTER.
Hull.
*February 24th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to Mr. Burbury's letter in the current issue, I think perhaps it would not be out of place to give some particulars of some low power experiments carried out by Mr. Burbury and myself. The arrangement was

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follows :—I called him up on full power and warned him of the reduction in powers and probable slight change in wavelength ; the generator was then stopped and the town lighting mains connected to the transmitter—the voltage was down, I dare say owing to a heavy load somewhere, to 220 volts. On changing over, Mr. Burbury reported clear C.W. and asked for speech, which was given ; changing over again Mr. Burbury reported good clear speech.

The meter readings are of considerable interest. My transmitter is designed for a high voltage, consequently 220 does not put much in as will be seen.

H.T. volts, 220.
Plate current, 7 milliamperes.
Power input = 1·54 watts.
Aerial radiation, ·01 amperes.

Distance between 2 AW and 2 QK is just over 20 miles.

Mr. Burbury was using 2 H.F. and 2 L.F. valves.

I was rung up immediately afterwards by a gentleman at Headingly, near Leeds (distance 14 miles), who had received this quite well on two valves.

Another reports from Keighly (10 miles) "received here, three valves," and finally one from Bramley (8 miles) on three valves also.

All these gentlemen reported good clear speech.

I think this has "cooked the American goose to a frazzle." Also I am convinced that I can halve this input and get as good results with some improvements I am incorporating in a new transmitter.

Finally I might add that I have used tuned transformer high-frequency coupling for about 14 months now, and I shall not change for anything that is going at present as I consider that as an amplifier for all and in fact any wavelength it is without its equal.

J. Bever.

85, Emm Lane,
Bradford. *March 18th*, 1922.

*To the Editor of* The Wireless World and Radio Review.

Sir,—With reference to my letter of 18th inst. I find I made a mistake about Mr. Burbury's receiver, which was a three-valve, not five as stated. It should read as follows :—

"Mr. Burbury was using 1 H.F., 1 rectifier and 1 L.F."

Further tests carried out yesterday are as follows :—

Input 230 volts 6 milliamperes.
Watts = 1·38.
Aerial radiation, 10 milliamperes.

I was received quite well by Mr. Ward 2 IQ, in Sheffield, approximate distance 45 miles.

J. Bever,
**2 QK.**

*March 20th*, 1922.

*To the Editor of* The Wireless World and Radio Review.

Sir,—Referring to Mr. Miller's paper, reported in your issue of December 24th, I noticed a similar effect produced in Army telephones (Stevens or D III), *i.e.*, that it is usually possible to read buzzer signals from a distant station in one's own microphone. Here the effect is unusually striking, because of the step-down transformer as which the induction coil acts. At the time I asked Dr. Eccles, I think, but time did not allow of investigating further. I mentioned it, however, as a curious effect in a book written in 1917 ("Practical Elementary Electricity." Harrison & Sons. Page 98).

R. Raven-Hart.
*Divisional Telegraph Engineer, B.A.P. Rly. Co.*

Union Club,
Necochea y Peru,
Mendoza.
Argentine Republic.
*February 24th*, 1922.

# Notes.

## Cancellation of an Amateur Licence.

The Wireless Society of London notifies us that at a Committee Meeting, held on the 15th of March, the cancellation of Post Office licence of the Altrincham Wireless Society, held in the name of its secretary, owing to contravention of its terms, was considered. The Society was offered the alternative of changing its Secretary or of abandoning its affiliation with The Wireless Society of London. The Altrincham Society have since chosen the latter course.

## 5GH and 5CO.

Can any reader say who are the telephony stations **5GH** and **5CO**, heard working in the afternoon ?

## Eiffel Tower Telephony.

Mr. A. Woodhams, a new member of the Wireless Society of London, who was in Paris recently armed with a letter of introduction from the Chairman, received much courtesy at the Eiffel Tower, and was permitted to hail his brother and a party of friends who were waiting expectantly at his flat near Piccadilly. The reception of speech, both French and English, was excellent.

## New Wireless Service.

In the Marconi Service opened on Wednesday, April 12th, between Berne and Ongar (in Essex) the wavelengths used and other particulars of the stations are as follows :—

Berne, call-sign **HBD**, wavelength 3,400 metres, 25 kW Marconi valve set.

Northweald (near Ongar, Essex), call-sign **GLA**, wavelength 3,800 metres, 15 kW Marconi valve set.

The Northweald station is one of a number of stations which are being erected on the same site.

## The P.M.G. and Broadcasting.

An appeal has recently been made to the Postmaster-General by the Central Landowners' Association to consider the desirability of including weather forecasts in any broadcasting of information by wireless telephone which may be introduced. The broadcasting of such information, which is, of course, conducted on an extensive scale in the United States, must here be submitted for approval to the Imperial Communications Committee, and the views of several Government Departments have to be considered in order that interference with essential services may be avoided.

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**Messrs. Burnham & Co.**, Deptford, S.E.8, desire to advise our readers that, owing to the growth of their business, their wireless department has been transferred to a company to be known as **Burndept Limited.** The new company will shortly open a factory, equipped for the production of their wireless apparatus, at "Aerial Works," Blackheath Village, S.E.3, three minutes from Blackheath Station, S.E. & C.R. New showrooms will also be opened very shortly at 228, Shaftesbury Avenue (New Oxford Street). All communications in the meantime should be addressed to Burndept Limited, St. Paul's Wharf, Deptford. The London retail depot will be at 19, Hand Court, until the new premises are ready.

**8AB.**

The station belonging to Mr. Léon Deloy, of 55, Boulevard Mont-Boron, Nice, has been heard on several occasions in this country. Mr. S. Hanley, of Kintbury, Berks, reports having heard **8AB** on the evenings of the 5th and 6th April, on 200 metres, on a single valve set. Mr. P. Smellie, of Edinburgh, using a four-valve H.F. tuned transformer amplifier, heard this station on the evening of the 8th March, on about 1,000 metres C.W.

**The Wireless Society of London.**

The next meeting of the Society will be held at the Institution of Electrical Engineers, at 6 p.m. on the 26th April, when Captain H. de A. Donisthorpe will open a discussion on "Four-Electrode Valves."

# Book Review.

ELECTRICAL ENGINEERING TESTING. By G. D. Aspinall Parr. (London: *Chapman & Hall.* Fourth Edition. Pp. 691 + viii. Figs. 296. 9″ × 5½″. Price 16s. net.)

This is a new edition of a well-known book by the former head of the electrical engineering department of Leeds University; it has been revised and enlarged and is now issued as one of the publishers' "Directly-Useful" Technical Series, which is intended to occupy a position midway between the purely theoretical and the ultra-practical books which can be obtained on almost every subject. The aim and scope of the book under review are indicated by its sub-title "A practical work on continuous and alternating currents for second and third year students and engineers."

Although this new edition contains much new material which will greatly increase its value as a laboratory text-book, we cannot but feel that in his attempt to bring the book "more thoroughly up to date" the author has not been altogether successful.

The illustrations given of oscillographs represent very ancient types which have long been superseded; two pages are devoted to instructions for making up the all-but-obsolete Clerk cell, whereas no such instructions are given for the Weston cell which has superseded it; not that we consider either a very promising experiment for a second or third year student of electrical engineering.

In many cases instruments which are mainly of historical interest are described at length without any hint to the student that they are now almost if not entirely obsolete. The reference to a parallel plate air condenser as an "Air Leyden" is very archaic and unusual.

It seems a great pity that better use was not made of the opportunity afforded by the preparation of this new edition of rewriting the obsolete sections and bringing the book entirely up to date. Some attempt has been made but in our opinion it has been too patchy and half-hearted.

The illustrations are very mixed, some very good and some very bad. There is a good index and an appendix containing a number of tables of useful data.

G. W. O. H.

# Calendar of Current Events

**Saturday, April 22nd.**

SUNDERLAND WIRELESS AND SCIENTIFIC SOCIETY.

"Aerial Design," by Mr. A. F. Stafford.

**Monday, April 24th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7.30 *p.m.*—At Signal Corps Headquarters, Park Street, "Winding Inductances by Machine," by Major Holman.

**Tuesday, April 25th.**

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (Tea, 5.30 *p.m.*).—At the Institution of Electrical Engineers, Victoria Embankment, W.C.2, "Four Electrode Valves," by Captain H. de A. Donisthorpe.

**Wednesday, April 26th.**

RADIO SCIENTIFIC SOCIETY, MANCHESTER.

Smoker and Exhibition.

TRANSMISSION OF TELEPHONY at 7 *to* 7.25 *p.m.* on 700 metres, followed by C.W. Calibration Signals on 1,000 metres, by **2MT** from Writtle, near Chelmsford.

**Thursday, April 27th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

"A System of Recording and Demonstration," by Mr. L. Haggard.

**Friday, April 28th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

*Selected.*—Mr. A. F. Carter, A.M.I.E.E.

**Saturday, April 29th.**

LUTON WIRELESS SOCIETY.

Public Exhibition.

SUNDERLAND WIRELESS AND SCIENTIFIC SOCIETY.

At the Technical College, "Telephony," by Mr. T. Brown Thomson.

**Wednesday, May 3rd.**

COWES AND DISTRICT RADIO SOCIETY.

"The Application of Three Electrode Valves to Transmitting."

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION).

6 *p.m.*—"Prevention of Interference in Wireless Telegraphy" (Provisional), by Mr. C. S. Franklin.

**Thursday, May 4th.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION

"Lantern Lecture and Demonstration," by Mr. Oswald Carpenter, Associate I.R.E.

**Friday, May 5th.**

WIRELESS SOCIETY OF HIGHGATE.

"Production of Low-Frequency Oscillations by the Valve," by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS' SECTION).

7 *p.m.*—"Electrically Oscillatory Discharges," by Mr. R. P. Howgrave-Graham.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Liverpool Wireless Association.*

A meeting was held on Thursday, March 23rd, at the Royal Institution. After the reading of the minutes and the transaction of formal business, the members adjourned to the Liverpool School of Wireless Telegraphy, Colquitt Street, where they were received by the principal (Mr. Woodland). The fine equipment of the school was much admired by the visitors, and Mr. Woodland went to considerable trouble to explain fully the various instruments and apparatus. Mr. Clemmey had brought down a short wave receiving set, and a musical programme was received from a local transmitting station. Mr. Clemmey, who is well known as an expert in telephony, was most kind in giving full details as to the working of transmitting sets. At the conclusion of the proceedings a hearty vote of thanks was given to Mr. Woodland and Mr. Clemmey for the trouble they had taken to render the evening so enjoyable and instructive.

The Hon. Secretary (Mr. Wilkie) is due to lecture on Thursday, the 13th inst., but as he is paying a short visit to West Africa it will be necessary to postpone the lecture until his return, in a week or two. It is regretted that, in view of the next meeting being fixed for the day before Good Friday, it has proved impossible to secure another lecturer.

### North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The eighty-eighth meeting of the Club was held on Wednesday, April 5th, and was well attended. The chair was taken by Mr. G. Evans, and after the minutes had been read he called on Mr. D. J. Stone to give his paper on "Electric Clocks."

Mr. Stone (by kind permission of the Synchronome Co.) had brought to the hall a master clock made by that firm and two wall dials, also the movement and hands of a large turret clock. These he had affixed in prominent positions, and they ticked off the half-minutes during the evening in the manner which is well known to most wireless workers. In addition, there were a number of diagrams, drawn to a large scale, which enabled the audience to follow the lecture with ease.

The lecturer started by giving a brief history of electric clock-making, saying that the idea of driving clocks by electricity existed very early in the days of electricity, but owing to practical difficulties it was found impossible to make these early types keep good time and at the same time be economical in current consumption. Mr. Stone described the different types of electric clocks, and pointed out the advantages and disadvantages of each. He then dealt in detail with the "Synchronome" system, which, he told his audience, was in his opinion and in that of many others, the best system so far invented. He explained the movement by means of various parts which were on the table, and laid particular stress on the extremely low current consumption, which amounted to only 3½ ampere hours per annum. Another special feature of this type is the very short duration of contact, and, further, the impulse given to the pendulum is independent of the state of the battery. Mr. Stone explained the ingenious method used when correcting these clocks by wireless. Some of the members present gave their experience of these clocks, and of other makes, and Mr. Stone answered many questions.

The meeting closed with a vote of thanks to the lecturer for the trouble he had taken and the pleasure he had given.

### Wireless and Experimental Association.*

A meeting was held on April 9th and was devoted to a discussion on the construction of high-tension condensers. The use of washed glass negatives and tinfoil was suggested, but it was pointed out that by this method condensers would be of inconveniently large dimensions.

Hon. Secretary, Mr. Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

### The West London Wireless and Experimental Association.*

Meeting held March 30th.—Listening-in on Association's apparatus gave exceptional strong signals, and all were able to hear the results by aid of the loud speaker. Informal discussion then followed, and many interesting points were raised, amongst which was data for frame aerials, the short wave tuner, the construction of condensers, etc. The Vice-President (Mr. F. E. Studt) in most instances replying to the satisfaction of the querists. The club's library is now possessed of "The Year-Book of Wireless Telegraphy and Telephony for 1922," so members will have up-to-date information respecting all the new large-power and amateur transmitting stations.

The Committee hope to arrange a summer half-day field day, including a visit to some not far-distant station.

Members are requested to make a special note of the demonstration by the Marconi Scientific Instrument Co., to be held on May 4th next. Also it is hoped that Messrs. H. D. Butler & Co. will demonstrate before the Association the following week.

The Secretary (Mr. Horace Cotton), 19, Bushey Road, Harlington, Middlesex) will be pleased to hear from any gentleman who desires particulars of qualifications for membership.

### Plymouth Wireless and Scientific Society.*

Wednesday, April 5th, was an open night so far as lectures were concerned. The meeting began with half-an-hour's buzzer practice. The business of the evening was "Complaints and Suggestions." members being invited to make any complaints or

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grievances and also to put forward suggestions for the improvement of the Society. The Committee were fully prepared to hear a long list of grievances against the management of the Society's affairs, and were gratified as well as surprised when none were forthcoming. Among the complaints of a general nature was the ever-recurring one of the impossibility of obtaining a transmitting licence in this neighbourhood. Stowed away as we are in a corner of the old country, with no amateur transmitting station within sixty or eighty miles, we have very little chance of experimenting in short wave reception. As far as telephony is concerned also we are in an unfavourable position for experiment. The amateur concerts are inaudible here, the Chelmsford weekly concert is an impossibility, due to interference from ships; the Dutch Concert is also too distant for us, shielded as we are by the heights of Dartmoor, so that before the commencement of the Paris telephony we were in a bad position. Fortunately, the French Concerts come in quite well, and prove a veritable blessing. Long may they continue, especially if they could only give us a little English now and then.

A suggestion was made that the Society hold a social and dance at a near date, and take that opportunity of giving a public demonstration of wireless telegraphy and, if the fates are propitious, telephony. The suggestion met with unanimous approval, and a sub-committee was at once elected to deal with the matter.

Full particulars of the Society may be obtained from the Hon. Secretary (Mr. C. H. Lock), 9, Ryder Road, Stoke, Devonport.

### Newcastle and District Amateur Wireless Association.*

On Monday, April 3rd, Mr. W. D. Owen, A.M.I.E.E., delivered an interesting lecture on the "Electronic Theory." This was very much appreciated by the members present, as this subject had never been dealt with at any previous meeting of the Society. We are looking forward to a further lecture promised by Mr. Owen.

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

### The Wireless Society of Hull and District.*

Mr. G. H. Strong presided over an excellent attendance of members at the fortnightly meeting, held on the 3rd. After the routine business had been disposed of and members' individual difficulties discussed, the rest of the evening was profitably spent in building up a complete receiving set, various members having brought down different pieces of apparatus. The set was duly assembled by Mr. W. J. Featherstone, and signals soon obtained. A topic which is being constantly discussed by members is the question as to whether this Society should purchase some apparatus with a view of erecting a permanent receiving station. Although the Committee have only recently decided, after much discussion, that the present is not an opportune time for this development, and the matter will be kept before them for future consideration.

Meetings of the Society are held fortnightly, on Monday evenings, at the Signal Corps Headquarters in Park Street, at 7.30 p.m., buzzer practice 7 to 7.30 p.m. Next meeting April 24th, when Major Holman will give an exhibition of winding inductance coils by machine. This gentleman has kindly offered to wind coils (duolateral) for any member if they will supply the wire. Wireless operators who happen to be in port will be welcomed as visitors at any meetings of the Society.

### Newark-on-Trent and District Wireless Society.

With the idea of stimulating the interest, a public lecture was held at the Magnus Grammar School, on March 15th, and to add to the interest the Society was honoured by a visit from Mr. W. R. Burne, the Transatlantic Tests winner.

The lecturer was Mr. T. Brown-Thomson, of Leeds, who gave an excellent lecture on Wireless Telephony. He fully explained, in as interesting a manner as possible, the propagation and reception of ether waves, illustrating by blackboard diagrams. The demonstrations of reception were accomplished by means of an Ultra IV. and two-valve note magnifier, and made audible to the whole audience by a Brown loud speaker. Several continental stations were tuned-in and the C.W. signals shrieked out loudly. An amateur telephony station was also picked up during the demonstration.

Mr. W. R. Burne then followed with a brief description of his reception from the American amateurs, which proved very interesting.

Six new members were enrolled, and it is hoped that anyone interested will communicate with the Hon. Secretary, 6, Beech Avenue, Hawtonville, Newark-on-Trent.

### Dick Kerr Wireless Society.

The Society was formed on February 28th and held its First General Meeting on Saturday, 25th ult., Mr. H. A. Cox in the chair. The rooms of the Society are situated at Ashton Park, Ashton, Preston, and membership is restricted to members of the Dick Kerr United Club. The apparatus consists of a multi-valve receiver with long, medium and short wave tuners, and loud speaker. Additional apparatus is available for experimental purposes. An inverted "L" aerial is used, conforming to the P.M.G. licence, and an internal frame aerial 7 ft. square is being erected for D.F. purposes.

The Officers and Committee are as follows:—*President*, Mr. R. Livingstone; *Vice-Presidents*, Mr. H. B. Player; Colonel C. Hardie, Mr. J. Conner; *Chairman*, Mr. H. A. Cox; *Vice-Chairman*, Mr. W. Paddock; *Hon. Secretary*, Mr. A. H. Topham; *Hon. Treasurer*, Mr. G. Masters; *Committee*, Messrs. A. Aldington, G. Davies, J. Isherwood, H. Simpson, L. H. Short and W. Swindlehurst.

The first message received on the Society's apparatus was a special message sent from Eiffel Tower through the courtesy of General Ferrié, of the French Army Wireless. An international ladies' football match in aid of the Rheims Cathedral Restoration Fund took place in the grounds of the Dick Kerr United Club at 5-45 p.m., and the following message was received at 6 p.m. on 2,500 metres:—

*Preston de FL. With our sincere gratitude to those who give their valuable help for the Rheims Cathedral Restoration Fund, we are expressing our heartiest sympathy to the Wireless Section of the Dick Kerr United Club. We wish all success to the members of this section, as well as to the organisers of the Football Match which is to be*

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*held to-day between the British and French Ladies' Teams.*

A special wireless concert sent from the Eiffel Tower an hour previously was received and made clearly audible. The articulation and modulation were faultless.

A series of lectures has been arranged comprising a complete course in the principles of Electro-Magnetic Wave Propagation and these will be given on alternate Friday evenings. The membership now stands at over 70.

The Society has received every support from the English Electric Co., Ltd., who have made a financial grant towards the initial cost of the apparatus.

It is hoped to install a telephony transmitter at an early date.

Hon. Secretary, Mr. A. H. Topham, Ashton Park, Ashton-on-Ribble, Preston, Lancs.

### Southampton and District Wireless Society.

A General Meeting was held at the Kingsland Assembly Rooms on Wednesday last, April 5th: a good attendance was recorded. It had been decided to hold a series of lectures for members, and the first of these was held on Wednesday last. The Chairman (Mr. Freeman) opened the meeting at 8 o'clock, and demonstrated on dry cells, after which Mr. Edwin Bateman gave a lecture on "Accumulators, Ohm's Law, Galvanometers," and finally the Wheatstone Bridge. Mr. Bateman, in a very lucid manner, dealt ably with all the above subjects, and at question time was subjected to a bombardment of questions, which, needless to say, he emerged from successfully. At the conclusion of the lecture a hearty vote of thanks was proposed, seconded, and carried unanimously, and an enjoyable evening was brought to a close at 10.15 p.m.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

### The Wallasey Wireless and Experimental Society.

On Thursday, March 23rd, the Society had the pleasure of listening to Mr. J. C. Mason's lecture on "Tuning." The lecturer opened by explaining the theory of self-heterodyne circuits; he dealt with this most important branch very fully, and then gave several valve circuits, giving the reasons for each one as he drew them. He also explained the theory and practice of spark and C.W. reception.

On the 20th inst., Mr. A. Lea read before the Society a most interesting paper on "Telephony." Mr. Lea has a good grip of his subject, and during his lecture illustrated difficult points with clear and concise diagrams. The paper was partly historical, partly theoretical and wholly interesting. Mr. Lea explained before he began that he did not call himself a lecturer, but was doing his best to be an example to the rest of the Society's members: he hoped that others would prepare and read papers for the Society's benefit. The meeting closed with a vote of thanks to Mr. Lea.

The Hon. Secretary (Mr. C. D. M. Hamilton), 24, Vaughan Road, will be pleased to send particulars of the Society to any prospective members.

### Sunderland Wireless and Scientific Association.

A General Meeting of the Association was held on Saturday, March 4th, in the Examination Hall of the Technical College. There were about 180 persons present. A paper on "A Wireless Set for £5" was read by the Secretary. Mr. MacColl outlined very briefly the action of a simple valve receiving set, and then proceeded to explain how one could be constructed at small cost. Signals were received on a loud speaker kindly lent by Messrs. Thos. Hudsons.

A General Meeting was held on Saturday, March 18th, when Mr. W. Guthrie Dixon, of the Newcastle and District Amateur Wireless Association, gave a most interesting lecture on the "Thermionic Valve." Mr. Dixon illustrated his point by a demonstration on a 7-valve set of his own construction.

On Friday, March 31st, under the auspices of the Association, a lecture on "Einstein's Theory of Relativity" was given by Mr. Robert Lunnon, M.A., B.Sc. (of the University of Durham), in the Subscription Library Hall, and was attended by over 200 persons.

On Saturday, April 1st, a General Meeting of the Association was held at the Technical College. The constitution and bye-laws which had been drawn up by the Committee were adopted. The President (Mr. G. Nelson, B.Sc., A.R.C.S., A.Inst.P.) gave an interesting lecture on "Electrons," which was illustrated by slides and some excellent demonstrations with vacuum tubes.

The Association's receiving set is now under construction. The Radio Communication Company have invited the Association to visit their offices at Newcastle-on-Tyne. The present membership is ninety-seven.

Hon. Secretary, Mr. H. G. MacColl, 1, North Elms, Sunderland.

### Reading Radio Research Society.

On March 25th last the above Society was formed, and the following officers were elected:—President, William Le Queux, Esq., Member I.R.E.; Chairman, Lieut.-Col. R. L. Pearson, A.M.I.E.E.; Hon. Secretary and Treasurer, Dr. L. L. Phillips, 73, London Street, Reading: Committee: Major H. MacCallum, B.Sc.(Lond.), A.M.I.E.E.; Messrs. J. E. Taylor, R. W. James, C.E. Tranter, W. H. Scarborough, F. B. White, E. A. Tunbridge and Captain F. M. J. White.

The objects of the Society are to promote the study of all matters connected with wireless telegraphy and telephony and kindred subjects, and to enable wireless amateurs in the district of Reading to meet one another, so that they may exchange ideas and obtain mutual help in the pursuit of their experiments. With this object in view it was thought well to allow time at the meetings for informal talk. It was hoped to form a library and a workshop for the use of members.

Rules were drawn up. It was decided that ladies could be admitted as members. It was decided to become affiliated to the Wireless Society of London.

The first meeting of the Society was held on April 3rd, when, despite very bad weather, quite a fair number of members attended to listen to a paper by Dr. L. L. Phillips, on the subject of X-rays.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only.* (2) *Queries should be clear and concise.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *Four questions is the maximum which will be accepted at a time.*

**"AMATEUR" (Rugby).**—(1) Set is satisfactory for spark, C.W. and telephony as it stands, except that a condenser is desirable across the telephones.

(2) Yes.

(3) About 50 turns, placed half a centimetre apart.

0·01 mfds. for the grid condenser will be suitable for the L.F.

**"R.K." (East Ham)** *submits a short wave receiver circuit and asks for criticism.*

A circuit of this type (impedance amplifier) is theoretically inefficient on short waves in exactly the same way as resistance amplifier is. We should strongly advise you not to use it below 1,000 metres, at which wavelength the values for the condensers, etc., will be about the same as in the normal resistance amplifier. An amplifier of this type needs very careful construction of the chokes with a view to keeping their self capacity low. If this is not low the chokes will by-pass a considerable amount of H.F. current, giving a serious weakness of signals.

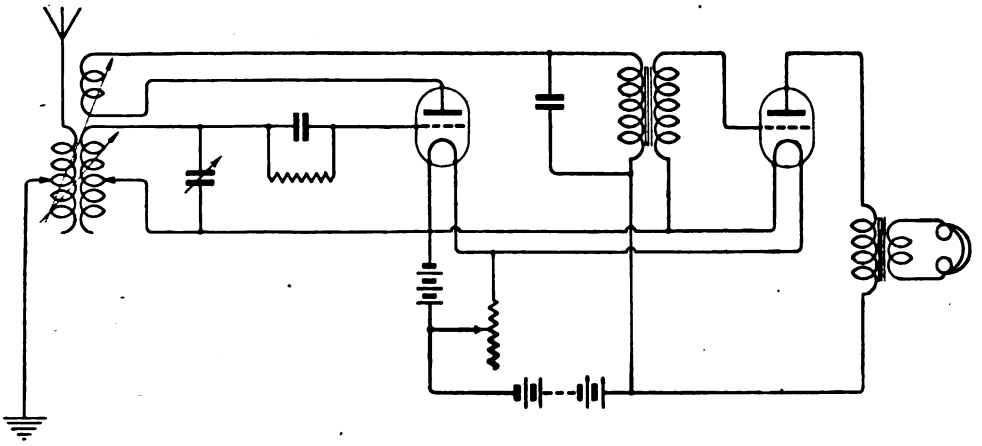

*Fig.* 1.

**"C.B." (Hyson Green)** *asks for a two-valve diagram, one valve detecting and the other L.F. amplifying.*

For suitable circuit see the diagram Fig. 1.

**"FORD" (Bexley Heath)** *asks* (1) *How to add a valve to an existing circuit.* (2) *Cost of an amateur's licence.* (3) *Maximum length of single wire aerial allowed.* (4) *If the English Concert will be heard on a crystal set with a valve magnifier.*

(1) See Fig. 5 or 8 in the March issue (queries column).

(2) 10s. per annum. Apply to the Secretary, G.P.O., London.

(3) 100 ft. including down-lead.

(4) Yes.

**"A.F.H." (Bishop's Waltham)** *asks* (1) *If special permission is required for the use of a frame aerial.* (2) *If a 60,000 ohm. resistance may be used in place of iron core transformer for a two-valve L.F. amplifier.*

(1) Only the usual permit for a receiving circuit is required.

(2) Yes, with a grid condenser and leak as in the usual resistance capacity amplifier. About

**"PERIKON" (Farnborough)** *asks* (1) *Which of two crystal circuits is the better.* (2) *If 30ft. high and 45ft. long aerial (twin) is suitable.* (3) *If it matters the set being at the same height as the aerial.*

(1) Your Fig. 2.

(2) Fairly good.

(3) Aerial should preferably be higher than the set.

(4) 4,000 metres with a 0·0005 mfd. condenser across the coil.

**"W.G.W." (Southsea)** *asks* (1) *If a circuit sketched is suitable for telephony.* (2) *How to add an additional H.F. valve.* (3) *If slab coils are preferable to solenoid coils for telephony.*



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(1) The circuit shown is satisfactory, except that it is liable to reradiate rather badly if carelessly used. A double tuned circuit with a loose coupler, or loose auto-coupling is preferable. Negative of L.T. battery should be earthed.

(2) Some rearrangement is necessary. Circuit should be on lines of Fig. 6, page 708, February 4th issue.

(3) Immaterial, if about the same size wire is used on each.

**"E.G.D." (Lingfield)** *asks* (1) *To whom to apply for a receiving permit.* (2) *If a heavily insulated lead-in should be used.* (3) *If lightning protector is essential.*

(1) To the Secretary, G.P.O., London.

(2) This may be done if you wish, but is not at all necessary.

(3) No, but the aerial and earth wires should be connected when not in use.

**"SPARKS" (Peebles)** *asks for help with a single wave set which used to give good results but now gives nothing on certain parts of its range.*

We cannot give you the exact reason for this without a detailed examination. It may be due to damp in the coils, which could be cured by drying out, or else to dirty switches or broken connections which can be detected by tracing out the circuits with a galvanometer.

**"J.H.A." (Acton).**—(1) The aerial is very poor. It should be much higher and preferably longer. It is of very little use to use four wires so close together, and would be just as good to have two wires fout feet apart.

(2) You do not give enough information for us to state the wavelength, but it will probably be as high as is useful for a crystal set.

(3) A crystal battery will not improve results appreciably.

**"H.F." (Deptford)** *asks* (1) *Whether a certain circuit is the best that can be done with his apparatus.* (2) *How a telephone transformer can be introduced.* (3) *If three or four Leclanche cells would improve the circuit.*

(1) Yes, except that the primary of the loose coupler should be on the earth side of the loading coil. A telephone transformer is essential with 120 ohm. telephones.

(2) See many circuits recently given.

(3) These might be used for a potentiometer with some good effect.

**"D.A.K.B." (Cheltenham)** *asks questions about a crystal set.*

The circuit shown is very poor. See diagram Fig.2 for correct circuit. A.T.I. may be 8" × 10" of No. 22. Closed circuit coils 8" × 5" of No. 26, with a 0·0005 mfd. condenser. There is no simple formula for calculating the range of the complete circuit. The closed circuit coil should slide into the A.T.I., which should be on a tube of ebonite or similar insulating material.

**"J.A.G." (Ealing)** *shows an adaptation of the Mark III Tuner and asks* (1) *approximate wavelength.* (2) *Connections for adding a valve.* (3) *If the set would then be suitable for concert reception.*

(1) About 1,000 metres without the aerial condenser and considerably less with it.

(2) See article in the June 25th issue.

(3) Yes.

**"V.F." (Brighton)** *asks* (1) *Cost of a "school valve receiving set," home made.* (2) *What issue gives diagram of circuit.* (3) *Whether it would give good results.* (4) *Who* **PCGG** *is, and what are the call letters of Carnarvon, Eiffel Tower and Nantes.*

(1) £3 to £6, including valve and telephones.

(2) See page 466, October 29th.

(3) Yes.

(4) **PCGG** is a telephone station at the Hague. Carnarvon is **MUU**, Eiffel Tower **FL**, and Nantes **UA**.

**"A.L.G." (Darlington)** *asks* (1) *For the wavelength of a receiver with honeycomb coils.* (2) *If the back-lash during C.W. transmission is due to harmonics.* (3) *If flat tuning causes* **MFD** *and* **FL** *to be heard.* (4) *If Stockton* **BYT** *is a receiving station only.*

(1) We cannot calculate the inductance of the coils, but expect the 8,750 metres is a true wavelength and not a harmonic. The presence of harmonics can in general only be proved by circumstantial evidence, such as their strength and approximate wavelength.

(2) No, this is not due to harmonics but to the method of signalling used, viz., keying by means of a small change of wavelength.

(3) No, it is more likely due to the coils having a natural wavelength somewhere about 2,500 metres.

(4) This was so during the war, and is so still as far as we know.

**"IVAN" (Mill Hill)** *asks* (1) *For an A.T.I. from 150 to 1,500 metres.* (2) *Quantity of wire required.* (3) *Particulars of 120 ohm. telephone transformer.* (4) *Call letters of Hendon.*

(1) 4" × 10" of No. 22 with a slider.

(2) About 1 lb.

(3) Core ½" diam. × 3" long of soft iron wire. Wind this with 6 ozs. of No. 30 for the telephone winding, and 3 ozs. of No. 44 for the crystal circuit.

(4) No information.

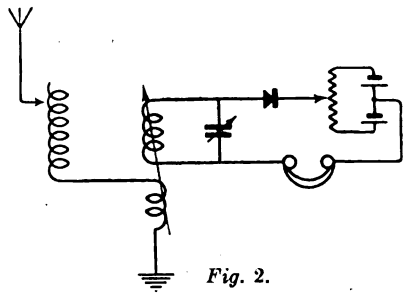

*Fig. 2.*

**"N.B.F." (Finchley)** *asks re Fig. 4, page 526, November 12th issue* (1) *The cause of rushing noises in the telephones.* (2) *If it would be an improvement to connect the negative H.T. direct to earth.* (3) *If the noise might be caused by the absence of a condenser across the change-over switch, and* (4) *What its capacity should be.*

(1) Various causes are possible, such as (*a*) a bad valve, (*b*) bad H.T. battery, (*c*) bad grid condenser or leak, (*d*) absence of condenser as in (3), (*e*) too tight reaction. We cannot say which of these causes is operating.

(2) No. The H.T. circuit has to be completed to the filament, not to the earth.

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(3) Very likely.

(4) About 0·001 mfds.

**"E.H.G." (Sheffield)** *asks if it is possible to add a two-valve resistance amplifier to an existing single-valve amplifier.* (2) *Wiring diagram of a circuit submitted.*

(1) This can be done. See diagram Fig. 3.

(2) The diagram you submit is as clear as any we could give you.

**"CHIKKO" (Acton).**—A telephone transformer is necessary for 120 ohms. telephones. For windings see reply to "Ivan," Mill Hill, above.

**"F.B." (Bayswater).** — (1) There are no general tables available of the number of turns, weight and gauge of wire, etc., for coils with particular condensers. If you state exact requirements we could probably give you the information you will need.

(2) There is no best arrangement of coils. Many

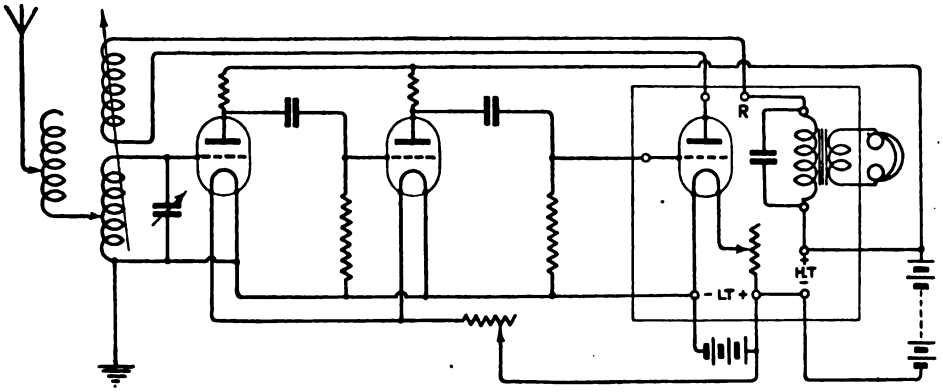


*Fig 2.*

different types of circuits are possible, as you will see by reference to diagrams in these columns.

(3) The use of the special winding machine you mention will not appreciably affect the size of the condenser to be used with the coils.

**"J.G.N." (Croydon)** *refers to Fig. 4, page 706, February 4th issue, and asks* (1) *The wavelength range of certain coils.* (2) *If it will receive* **PCGG** *at Croydon.* (3) *Ratio for the L.F. transformer.* (4) *If a small condenser would be advantageous across the reaction coil.* (5) *If the condenser across the switch is necessary, and if so what size it should be.*

(1) Probably about 7,000 metres.

(2) Yes.

(3) 1 to 2 or 2 to 3.

(4) No; this is undesirable.

(5) Yes. A fixed condenser 0·002 mfd. would be about right.

**"C.T.A." (Leicester)** *wishes to make a 180 metre telephone transmitter, and asks* (1) *Whether to use inductive coupling between circuits or a single circuit transmitter.* (2) *For a rough idea of the windings.*

(1) The second type will be quite suitable for a set of this nature.

(2) The inductance may be wound with about 24 turns of say No. 18 wire on a 4" diam. tube, the turns being spaced about $\frac{1}{16}$" apart. About half this coil should be in the plate circuit, and about half in the grid. For further information see page 866, March 19th, 1921.

**"—." (Uppingham)** *asks* (1) *For coils suitable for a set from 200 metres to 10,000 metres.* (2) *Advantages of certain arrangements of valves.* (3) *For diagram of resistance coupling set.* (4) *If an ordinary loose coupler will do for A.T.I. and reaction in a valve set.*

(1) For a big range like this you will require a set of honeycomb coils, the biggest of which should have about 400 turns with a mean diameter of 3", and the smallest can have about 30 turns, mean diameter 2".

(2) One H.F., one detector and one L.F. is a very good arrangement. Two H.F. alone is probably the best way of using two valves. Two L.F. alone is rather poor.

(3) See Fig. 3, page 640, January 7th issue, but making the grid condenser about 0·01 mfd.

(4) Yes, for moderate wavelengths. Gauges and sizes will depend on the range required.

**"L.H.P." (Market Harborough).**—(1) The general idea of the set is correct, but we fail to see the purpose of the condensers attached to the negative of the H.T. battery. This point should be connected to earth.

(2) A detailed design for a telephone transformer was given in March, 1920. For rough dimensions see reply to "Ivan," Mill Hill, above.

(3) No, we regret we are unable to supply complete constructional information for circuits given in these columns.

(4) H.R. telephones may be used in a single valve receiver if placed on the earth side of the H.T. battery, but their use is undesirable if more than one valve is employed.

**"F.D." (Nelson)** *asks* (1) *For a frame aerial set suitable for use up to 5,000 metres.* (2) *What additions will be necessary to receive* **PCGG**. (3) *For full details of the apparatus.* (4) *For a good book on the making of amateur sets.*

(1), (2) and (3) See issues 16 to 22 of Vol. 8, which may be obtained from the Publishers, and will give you all the information you require. This set will receive **PCGG** without alterations.

(4) "The Construction of an Amateur Valve Station," shortly to be published.

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**"L.G.B." (Wandsworth)** *asks* (1) *If it is correct to use iron cores in transformers for wireless telephony.* (2) *If so, gauge and quantity of wire required.* (3) *How to determine the capacity of a condenser.*

(1) For L.F. and telephone transformers, yes. For H.F., no.

(2) This depends on the type of transformer. See replies to various enquirers.

(3) There is no very simple way which does not necessitate the use of apparatus. You might connect a coil across it, buzz it and determine the wavelength, which would be given by the formula wavelength $1885\sqrt{LC}$.

**"V.H.C." (London).**—(1) *For a circuit to utilise certain apparatus.* (2) *For value of grid leak.* (3) *For suggestions.* (4) *If a certain tuner may be used as reaction.*

(1) With a little additional apparatus a circuit shown in Fig. 1, January 7th issue, may be used effectively.

(2) The grid condenser and leak 0·0005 mfd. and 2 megohms respectively, may be connected in the grid circuit of the second valve.

(3) and (4) We have no detailed knowledge of this tuner and cannot say whether it would be suitable for the purpose required. It may be possible to use it as the secondary and reaction circuit in the diagram recommended with your small former as an A.T.I.

**"N.W." (Liverpool)** *asks* (1) *For criticism of a three-valve set.* (2) *For capacity value of two condensers.* (3) *For wavelength of a loose coupler.* (4) *For information regarding duolateral coils.*

(1) The circuit is quite good except that it is risky to use valves of different make with common H.T. and grid potentiometers owing to the differences in their characters. Use the potentiometer for the second valve only.

(2) C.1 is 0·0003 mfds. and C.2 0·0004 mfds.

(3) Aerial circuit maximum 5,500 metres with condenser C.1; secondary circuit with condenser C.2 maximum 6,500 metres.

(4) Information about these coils is given in the issue of 30th October, 1920, which can be obtained from the Publishers.

**"H.W." (Liscard)** *asks how long a 30-ampere hour accumulator will light four "Ora" valves.* (2) *How to recharge from A.C. mains.* (3) *For a good book on accumulators.*

(1) If 30 ampere hours is the continuous discharge rate, the cell will run the valves for about ten hours. If 30 ampere hours is the ignition rating, it will run the valves for about six hours.

(2) This can be done fairly cheaply by means of a "Nodon" valve, which is described in the issue of 19th March, 1921, or by means of a "Tungar" rectifier, as marketed by the B.T.H. Co. This is a better piece of apparatus, but much more expensive.

(3) "The A.B.C. of Storage Battery Management," by Ernest McKinnon (Electrical Press).

**"J.T." (Cheshire)** *asks* (1) *For a circuit to use certain apparatus.* (2) *If the set will receive C.W., telephony and spark.* (3) *For maximum and minimum wavelengths for given inductances.*

(1) The circuit will follow closely on the lines of the one given to "M.W.L." (Brentwood), above.

(2) Yes.

(3) Minimum about 300 metres, maximum about 3,000 metres.

**"E.M." (Wimbledon)** *asks* (1) *Which is the better of two kinds of aerial wire.* (2) *Dimensions of grid and anode coil for telephony transmission on 1,000 metres.* (3) *With what wire to wind an eight slot former for 1,000 metres.*

(1) There is no difference. We slightly prefer the 12/26.

(2) We cannot answer this without further particulars as to the circuit in which they are to be used.

(3) For the H.F. transformer the wire should be No. 44 gauge, but the number of turns can only be determined experimentally.

**"A.R." (Stockport)** *asks* (1) *For method of connecting two valve panels together.* (2) *If connections of first panel are correct.* (3) *If the set is suitable for telephony.*

(1) If the terminals EF are connected to AB, and with the switch at A1, the magnified oscillation will be put on to the second valve for rectification. Connect a 0·001 mfd. condenser across the L.F. transformer winding, which is in the anode circuit of No. 2 valve. It will be correct to connect the L.T. and H.T. to both sets of terminals.

(2) Yes, except that the lead which at present goes from the secondary inductance and condenser to the + 6 volt terminal, should go to the — 6 volt terminal.

(3) Yes, providing the windings are suitably proportioned.

**"V.N.N." (India)** *asks questions relative to the connection of grid and anode circuits to the negative side of the filament.*

It is impossible to give a general rule as to which side of the filament the grid should be connected to, though generally it is better to connect it to the negative side. It is customary to connect the — H.T. to the + L.T. Although this is not essential it is as well to have a rule to work to, to avoid cross connections when several pieces of apparatus are used on one set of batteries. There are not many four-electrode valves in use at present. They have been tried for various purposes, sometimes to do the work of three-electrode valves and also to give more amplification than can be obtained with a single three-electrode valve.

**"BASKET COIL" (Birmingham)** *asks* (1) *If a dry battery can be used for lighting filaments.* (2) *Why accumulators are always used.* (3) *If in the "school receiver" any ill-effects will result from altering the lengths of the leads.* (4) *If he should use solenoid or pancake coils.*

(1) Yes; but only if of very largest size obtainable, and for quite short periods.

(2) Chiefly because of the very great expense of providing the necessary fairly heavy and steady currents by means of dry cells.

(3) No, provided the alterations are only moderate in amount.

(4) Immaterial.

**"BEGINNER" (Kenilworth)** *asks for a telephone transformer for telephones of 500 ohms. per earpiece.*

Telephones of this resistance are best used without a telephone transformer, which, if made, would not be very efficient. The most suitable winding is primary 2½ oz. No. 44 S.S.C. wound over a secondary of ¾ oz. No. 42 S.S.C.

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**"J.H.G" (Forest Hill)** *asks* (1) *For a set to receive* **PCGG.** (2) *If valve and crystal set of April and May,* 1920, *or a single valve set would be most suitable.* (3) *For a diagram to modify the valve and crystal set.* (4) *For a loose coupler tuned to 400 metres.*

(1) See page 67, April 30th, 1921, issue.

(2) and (3) The valve and crystal set with additional note magnification should give very good results. The three-valve amplifier referred to is not suitable for this set. Do not cut out the crystal rectifier.

(4) Primary 4"×8" of No. 22; secondary 3"×6" No. 26, tuned with a 0·0003 mfd. condenser.

**"W.S." (Blackburn)** *asks questions about screening receiving circuits.*

Broadly speaking, copper or zinc should be used for H.F. screening, and iron for L.F. Two thin screens inside each other is far better than one thick screen. Screening should not be of perforated material, and in fact should have as few holes in it as possible. All joints should be well soldered together and the screens should be earthed. The screens should not be too close to windings.

**"C.V.H." (Ludlow)** *asks* (1) *For criticism of a three-valve set.* (2) *If coils are suitable for a given range.* (3) *For criticism of the aerial.*

(1) Circuit is O.K. Condenser C.6 would be better than C.5, which is rather small. The basket coils for reaction, and reaction coupling coil 3, are too small. Better results would be obtained with a 3" former with 8" of No. 32, made to slide in and out of the secondary.

(2) Yes.

(3) Little would be gained by changing the position of the wire or the lead in. It would have been simpler in the first place to take the lead-in from the end of the wire, thus saving the work entailed in making the joints.

**"HETERODYNE" (Nottingham)** *describes a single valve set and asks if satisfactory.*

Aerial circuit is satisfactory. The secondary circuit should be tuned by a variable condenser, at present only shown dotted. The telephones should be in series with the anode battery, preferably with a 0·001 mfd. condenser across them. Reaction coil connected between positive H.F. and anode of the valve and coupled to the secondary circuit would be a great advantage. This coil may be 3"×8" No. 28. Closed circuit condenser may be 0·0003 mfd.; maximum wavelength would then be 4,000 metres.

**"N.M.J." (Luton).**—(1) Range will be from 300 metres up to 10,000.

(2) Under conditions such as these the maximum wavelength is given very closely by that of the combined capacity and inductance, which may be calculated from the ordinary formula.

(3) For long wavelengths use a reaction coil somewhat smaller than the main coil; for short somewhat bigger.

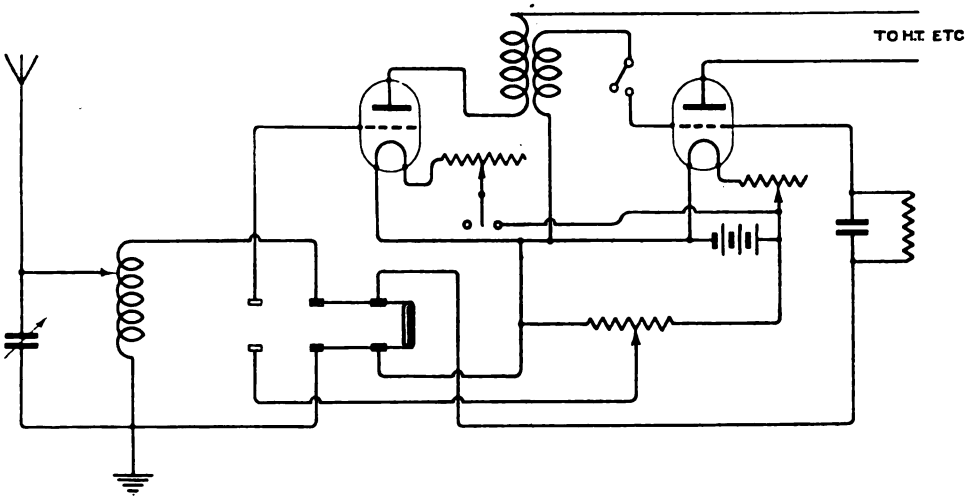


*Fig.* 4.

(4) It is better to use separate coils and not tappings on the coil.

**"C.C.J." (Weymouth)** *asks* (1) *If basket coils wound with No.* 42 *gauge wire will do for his circuit.* (2) *What is* (*a*) *the cheapest and* (*b*) *the most efficient way of adding a valve to his set.*

(1) No. 42 gauge is much too fine. The resistance added to the circuit by its use will prevent satisfactory results being obtained as well as being very difficult to wind. Do not use finer than about No. 32.

(2) (*a*) Probably the cheapest is to add as an L.F. amplifier, but (*b*) addition as H.F. valve, with either transformer or resistance coupling should be more efficient.

**"E.W.S." (West Norwood)** *asks for a diagram of a circuit to fulfil certain requirements.*

Capacity reaction is unsuitable for use in a circuit where the number of valves to be employed is to be altered. With magnetic reaction retained the first two valves should be as in the diagram Fig. 4, remainder of the circuit should be as in Fig. 4, page 526, to which you refer.

**"B.H.T." (Hythe)** *asks what will be the most suitable form of set for an amateur having no access to a supply of electricity.*

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If you have no facilities for charging accumulators, the use of valves is almost out of the question and you are therfore reduced to the use of a crystal set, which is quite capable of giving good results in a somewhat limited sphere of application, or to the use of one of the various methods described in the article you refer to, all of which are, however, far inferior to the corresponding valve methods.

**"T.P.M." (Derby)** *asks* (1) *For criticism of a circuit supplied.* (2) *If it will work from* 200 *to* 25,000 *metres with suitable coils.* (3) *Which are better, slab or honeycomb coils.* (4) *If a separate heterodyne can be used.*

(1) The set is satisfactory as it stands.

(2) Amplification would be very poor below 700 or 800 metres.

(3) Honeycomb coils are somewhat the better.

(4) Yes. Introduce a coil in one of the H.F. grid circuits, coupled with the oscillating circuit of the heterodyne. The stronger the heterodyne the nearer to the rectifier it can be introduced.

**"M.W.L." (Brentwood).**—The results you are getting seem fairly good, but we should prefer a stage of H.F. amplification. Also ebonite would be much better for formers. For assistance in obtaining short wave signals see the reports published in recent issues on the reception of the short wave Transatlantic signals.

**"E.S." (Enfield)** *asks re the single valve long wave receiver of February,* 1921. (1) *If the capacity may be made up by a* 0·0007 *mfd. variable with fixed mica condensers in parallel.* (2) *If the two units described may be put side by side in one case without ill effect.*

(1) Yes.

(2) This is inadvisable unless the coils are kept fairly well apart and turned at right angles to each other.

**"HETERODYNE" (King's Sutton)** *asks* (1) *For criticism of set.* (2) *Best arrangement for telephony.*

(1) and (2) The whole set is of very indifferent type. It should be rearranged as in the diagram (Fig. 5). At least 45 volts should be used with an "R" valve.

**"INDUCTANCE" (Huddersfield)** *asks* (1) *For windings for a receiver from* 300 *to* 25,000 *metres.* (2) *For the difference between H.F. and L.F. amplification.* (3) *For information about a H.F. amplifier.* (4) *Criticism of a receiving circuit.*

(1) You will require a series of honeycomb coils ranging in size from about 40 turns to 1,000 turns with a mean diameter of 3".

(2) H.F. amplification is amplification of incoming signals before rectification. L.F. amplification is amplification of the telephone note after rectification.

(3) See Nos. 41, 42, 43 and 52, of Vol. 9.

(4) The circuit is quite correct.

**"C.B." (Doncaster).**—We should advise you to read an elementary text book, such as Bangay's "First Principles." Your only essential apparatus for a crystal set is an inductance with a slider, a variable condenser, a crystal with potentiometer, and a pair of high resistance telephones. For diagram see reply to "D.A.K.B." (Cheltenham), above, but arrange the slider on the closed circuit coil and the earth to one of its ends. Two dry cells only will be required. Aerial should be as large as possible up to the maximum of 100 ft. allowed.

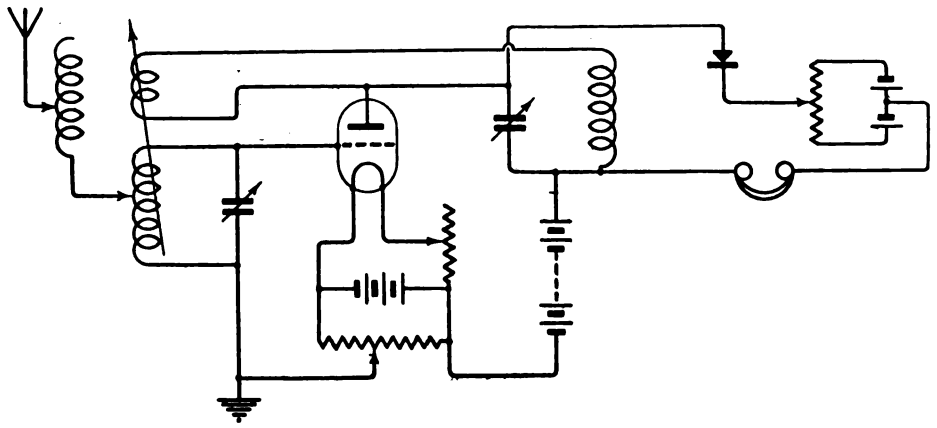

*Fig.* 5.

**"RADIOCON" (Battle)** *asks* (1) *Which of two circuits is the best for general purposes.* (2) *Maximum capacity of condenser across primary of H.F. transformer.* (3) *If a* 6 *volt dry battery as used for car lighting could be used for the filaments.* (4) *Best wire for connecting parts of the set.*

(1) That of Fig. 3, page 674.

(2) Generally about 0·0005 mfd.

(3) Probably, but would be rather expensive.

(4) Rubber covered flex of about 2 ampere carrying capacity.

**"T.W.A." (St. George's)** *asks questions about crystal set.*

(1) The wiring should be as in reply to "C.B." (Doncaster).

(2) Wavelength ranges will only be a few hundred metres. Increase the A.T.I. to about 6" × 10".

(3) An additional valve would improve results. You will find many circuits in these columns, but we should advise you to experiment with a crystal set first.

(4) Yes, but even your crystal set will receive telephony from fairly near stations.

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"——." **(Upper Tooting)** *asks* (1) *Whether capacity reaction or a separate heterodyne would be best for the set described in January 8th, 1921, issue.* (2) *If aluminium wire could be used for a frame aerial.* (3) *For winding of a frame for* 3,000 *metres.*

(1) If you are referring to a frame aerial set, a separate heterodyne would be preferable.

(2) Aluminium wire could be used, but would have no special advantages. Gauge should be about No. 16.

(3) About 50 turns, spaced about one centimetre apart, with taps at the 10th and 25th turn.

"**DELTA**" **(Gosforth)** *asks for value of capacity, inductance, etc., for each circuit of a three circuit receiver for* 1,000 *metres.*

(1) A.T.I. 1,500 mhys. Intermediate condenser should be large, say 0·002 mfd., in which case the inductance of the two coils which are in parallel should be 300 mhys. each. Resistance of all circuits should be small. Coefficient of coupling should be about 5 per cent.

"**K.S.L.**" **(Bournemouth)** *refers to Fig.* 5, *page* 706, *February 4th issue, and has added an additional switch to cut out the H.F. valve and use either a crystal of valve rectifier, and asks for criticism.*

Only a single-pole switch is necessary to change to either grid or crystal. The filament switch of No. 2 valve is wrongly connected. It should have nothing to do with the telephones, and as at present arranged, it does not light the valve.

"**CLIVE**" **(Welshpool)** *asks* (1) *The potential difference between the earth and the atmosphere at heights of* 50′, 100′ *and* 150′. (2) *For the specific heat of air.*

(1) There is no definite value. At times it is negligible, at others considerable with either sign. The values depend on climatic conditions and we are unable to give you definite figures. It may be as high as 50 volts per foot, the atmosphere being generally positive to earth in fine weather.

(2) This is not a wireless question and we should advise you to consult a good text book on theoretical physics, as air being a mixture of gases has more than one specific heat. However, we may say that the specific heat at constant pressure is roughly $6{\cdot}5 + 0{\cdot}0005$ T, where T is the centigrade temperature.

"**J.T.L.**" **(South Norwood).**—(1) The coupler is not very good as the resistance of the primary will be too high. This will prevent it being used for crystal work, but it might be used for reaction in a valve set.

(2) 0·0034 mfds.

(3) This depends on the use to which the coils are to be put. Without knowing the circuit we are unable to give you values.

"**C.G.B.**" **(Newport, Mon.)** *asks for suggestions as to extending the range of a German tuner.*

As this tuner is designed for efficient short wave reception it will be difficult to extend the range without dismantling. Completely strip out all the winding, remove wire from formers and rewind the large diameter A.T.I. with a two pile winding, and smaller diameter portion with a row of basket coils. Wind the rotating former with a four-pile winding and use as reaction. Arrange the barrel switches to eliminate dead end effect. Remove the buzzer, substitute a valve holder and connect up as a reaction tuner with tuned plate circuit. The "Zelle" and "Prufentaste" keys may be connected for short and long wave tuning.

"**B.H.C.M.**" **(Portishead)** *asks* (1) *Why, in a simple one-circuit crystal set the current goes through the high resistance of the crystal and telephones rather than through the low resistance of the A.T.I.* (2) *If it would be better to wind the A.T.I. with No.* 34 *instead of No.* 36. (3) *What are the times, etc., of the half-hour weekly telephony.*

(1 and 2) For an adequate treatment you should see a book such as Bangay's "First Principles." We may point out that for the very high frequencies employed in wireless the inductance of the A.T.I. makes it offer a great impedance to the passage of current in spite of its low ohmic resistance. Using No. 34 wire is undesirable as it increases the ohmic resistance which leads to bad tuning and a weakness of signals.

(3) Tuesday evenings, 7 to 7.30 p.m., ¼ kW., wavelength 700 metres.

"**H.C.**" **(Brighouse)** *sends sketch of a circuit and asks* (1) *Particulars of intervalve transformer and telephone-transformer.* (2) *Values of certain condensers.*

(1) Intervalve transformer, 1 oz. and 3 ozs. of No. 44, wound on a core of iron wires ½″ diameter by 3″ long. For telephone transformer, see reply to "**IVAN**" **(Mill Hill)** recently.

(2) C about 0·001 mfd., D about 0·0005 mfds.

"**C.W.S.**" **(Hurstpierpoint)** *refers to Fig.* 10, *page* 726, *February* 18th *issue, and asks* (1) *For values of condensers.* (2) *If suitable for a beginner.* (3) *If certain gear is suitable for the circuit.*

(1) The A.T.C. about 0·001 mfd. and the anode condenser 0·0005 mfd.

(2) We do not like this circuit at all. It will give great sensitiveness at times, but a double tuned circuit of this kind is always very tricky to handle. It will give serious reradiation, and the telephones should be on the earth side of the H.T. battery, and should also be shunted by a condenser. We should advise you to omit the 0·0005 mfd. condenser, to begin with at any rate.

(3) Yes.

"**TYRO**" **(London)** *asks* (1) *For a descriptive book on wireless dealing with the earlier work and also the more modern.* (2) *For a book describing the construction of a single valve receiver.*

(1) Most of the earlier books describe the initial work well. A good modern descriptive book is "Stanley's Wireless Telegraphy." More elementary books are "Bangay's First Principles" and his "Oscillation Valves."

(2) We do not know of such a book, but articles on the subject appeared in the issues for February 5th, 19th, and March 19th, 1921.

"**NIVICE**" **(London)** *asks* (1) *The cost of a small complete valve receiver, capable of receiving* PCGG. (2) *What instruments will be necessary to build one.*

(1) It is difficult to give exact figures as so many different types of set are possible. You should be able to buy a set complete with batteries, etc., for from £10 to £15. If you made it yourself it would cost about half this.

(2) Aerial, various tuning coils, two variable condensers, about two valves, filament battery, H.T. battery, filament resistance, telephone transformer, one or two block condensers and a pair of telephones.

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**"J.E.S." (Oundle)** *sends sketch of a circuit and asks if it is correct.* (2) *If he can use No.* 32 *wire.* (3) *If a condenser of a type described will be useful.* (4) *If it can be used for the circuit shown.*

(1) No. The primary of a coupler should be in series with the A.T.I. and not in parallel with it.

(2) For useful wavelength range coils should be bigger than you suggest; A.T.I. say 6" × 12" of No. 22; coupler primary 4" × 3" of No. 22; Secondary, 7" × 5" of No. 26.

(3) Condenser should be fairly satisfactory if the plate systems are well insulated from each other with ebonite or similar material, but you will probably find the calibration will vary considerably from time to time.

(4) Yes. Your potentiometer arrangement is incorrect.

**"W.R." (North Shields)** *submits a diagram and asks for criticism.* (2) *If vulcanised fibre sheet may be used for mounting the set.*

(1) Set is O.K., except for the anode circuit arrangement. It is undesirable to pass the current from both valves through the telephones. The iron-cored winding in series with the reaction coil should have a condenser across it. The connections of the anode circuits may be as in Fig. 3, page 674, in which the telephones are supposed to be inserted across the 0·001 mfd. condenser.

(2) This material, if of good quality, should be quite satisfactory, providing your operating room is kept fairly dry.

**"THOMAS McGEE" (Hampton-in-Arden).**

(1) The set will probably work with these coils.

(2) Try about 0·001 mfd.

(3) Yes.

(4) Difficult to say exactly, probably up to about 600 metres.

**"J.B.B.M." (Bothwell)** *refers to Fig.* 12, *page* 726, *and asks* (1) *For dimensions per coil.* (2) *If "Ora" valves could be used.* (3) *What H.T. battery would be required.* (4) *If it should receive* **2MT.**

(1) About 9" × 5" of No. 26. The coil should, of course, have a slider.

(2) Yes.

(3) About 60 volts.

(4) It might, but we do not think a great deal of the merits of this circuit.

**"J.B." (Sittingbourne)** *submits a diagram of a two-valve set and asks* (1) *If it is the set or his own inexperience which prevents him getting* **PCGG.** (2) *How the valves function.* (3) *If it is correct to prevent reradiation by using as much filament resistance as possible.*

(1) We see no reason why the set should not receive **PCGG.** Failure is probably due to inexperience as you suggest.

(2) The first valve is H.F. amplifying and the second detecting.

(3) This will do so, but only at very serious expense of weakening of the signals. The results should be obtained by coupling the aerial very loosely to a closed circuit attached to the grid and filament of the first valve.

**"AMATURE" (Ramsgate)** *sends a diagram of a four-valve circuit and asks* (1) *For criticism.* (2) *If it should receive* **PCGG** *at* 500 *miles on a P.M.G. aerial.* (3) *Value for leaks.* (4) *If he should hear* **BYZ** *on a frame aerial.*

(1) Quite O.K., except more H.T. volts, say 80 are desirable.

(2) Yes.

(3) 2 to 5 megohms.

(4) Probably with a good frame of large dimensions.

**"V.B." (Reading).**—It is of no use your merely loading your aerial up to the wavelength of a normal P.M.G. For satisfactory results you will require to tune for much longer wavelengths than this, say 3,000 metres. For this purpose your coils should be about 6" × 10" wound with No. 22.

**"W.E." (Waterlooville)** *sends a diagram of a crystal receiver and asks* (1) *The use of a high resistance coil connected across the aerial and earth terminals.* (2) *For windings for* 7,000 *metres.* (3) *If certain samples of wire might be used.*

(1) This coil is a static leak, to prevent any charge picked up by the aerial from accumulating on the aerial condenser and finally discharging across it.

(2) With the A.T.C. used in parallel, A.T.I. might be 6" × 8" of No. 22; primary, 3½" × 12", also No. 22; secondary, 4" × 12", of No. 28.

(3) No. 2 or 3 will probably do for the aerial circuit. No. 4 or preferably 5, for the closed circuit.

**"S.A.W." (Croydon)** *sends a diagram of a two-valve set for criticism, and asks* (2) *If it will receive* **PCGG.**

(1) Circuit is satisfactory, except that reaction coil should couple with closed circuit coil and not with the A.T.I., and also there should be a capacity of about 0·001 mfd. placed across the telephone transformer primary.

(2) Yes.

**"F.S.G." (Derby)** *sends sketches of two circuits and asks* (1) *If correct, and if the three-valve circuit will receive* **PCGG.** (2) *For criticism of a frame aerial.* (3) *Capacity of two condensers.* (4) *What telephone arrangement would be best.*

(1) Crystal circuit is poor. See circuit in diagram given to "C.B." (Doncaster). Valve circuit is in order.

(2) O.K.

(3) About 0·001 mfd. each.

(4) L.R. telephones with transformer is best. H.R. telephones with a 1/1 transformer are generally inefficient, and H.R. telephones alone are undesirable in a multivalve set.

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## SHARE MARKET REPORT

Prices as we go to press, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 4 | 9 |
| ,, Preference .. .. | 2 | 3 | 0 |
| ,, Inter. Marine .. .. | 1 | 9 | 6 |
| ,, Canadian .. .. | | 8 | 0 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | | 15 | 6 |
| Preference .. .. .. .. | | 14 | 3 |

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THE
# WIRELESS WORLD
AND RADIO·REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

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## C.W. Reception Viewed from Another Standpoint

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

THE reception of continuous wave signals introduces different problems to those encountered with the simpler receivers which were utilised for "spark" or damped wave reception only. As is generally well known, it is necessary either to cut up the transmitted waves into periodic groups following each other at an audible frequency, as is done in "Chopped C.W.," and in "Tonic Train" transmission, or to apply some similar method at the receiving end of the circuit. If this is not done, each dot and dash will merely give rise in the telephones at the receiver to a current which remains sensibly uniform throughout the duration of the signal.

The desired result will obviously be obtained if the received telephone current is interrupted by some suitable contact or commutator at a frequency within the audible range, so as to allow the flow through the telephones of repeated pulses of current during the continuance of the signal. Such an interrupter can be constructed out of a vibrating contact, such as a tuning-fork provided with a driving magnet and contact in addition to the contacts in the telephone circuit, or by any convenient form of rotary commutator that will give the desired frequency.

Various simple arrangements of this type—"tikkers" as they are usually called—have been described recently in these columns.* It may, however, be of interest to point out that the motor-driven commutator that was fitted into the various patterns of "Wilson" spark transmitting apparatus may be utilised for this purpose. Numbers of these motor-driven commutators have been sold by the "Disposals Board," and some interesting experiments on these lines can be performed with them. They may also, of course, be utilised if desired as a "chopper" in a C.W. transmitting circuit of small power to enable chopped C.W. to be sent out.

The more usual method used for receiving continuous waves is based upon applications of the "heterodyne" method in one or other of its forms, in which the incoming high-frequency oscillations forming the signal are caused to react with a supply of high-frequency oscillations produced locally, the frequency of the local oscillations being nearly the same as that of the incoming signal, so that "beats" are set up between them, much in the same way as beats are produced acoustically between two sounds of nearly the same pitch.

All of these methods can be considered from the viewpoint of *modulating* the steady C.W. by some means or other, so as to impress upon it some variations which will be of acoustic frequency. This modulation may be applied at either the transmitting or at the receiving end of the circuit, and there are, perhaps, some advantages in considering the question in this way. Everyone who has operated, or has listened to a radio-telephone transmitter will be familiar with the term percentage of modulation, and of the effects obtained when the percentage modulation is too low. A similar loss of effectiveness can and does occur when the "percentage modulation" of the C.W. receiver is too small.

For the sake of example, let us consider a few typical cases in turn. Taking first the modulation of the radiated waves from the transmitter, as in "tonic train" or "chopped C.W." transmission. This case is evidently very similar to ordinary radio-telephone modulation, so that a similar reasoning as to the percentage modulation applies. If this modulation is effected by feeding the transmitting valve with single-phase alternating current for tonic-train transmission, or by actual periodic interruption of the transmitting aerial circuit by some suitable form of commutator or interrupter, as in "chopped C.W." transmission, the percentage modulation will be all that is desired. If, however, the modulation of the transmitted radiation is effected by setting up two transmitting circuits of nearly the same oscillation frequency, using either closely adjacent but separate aerials, or by appropriate coupling to one common aerial, so that a beat frequency within the acoustic limits is produced, then the percentage modulation may or may not be satisfactory depending mainly upon the relative intensities of the two oscillating currents.

At the receiver, however, the conditions are very different, and the percentage modulation, if we may use the term in this case in the sense referred to

*Wireless World*, 9, pp. 652–659.

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above, may vary within quite wide limits. For example, consider the reception of C.W. signals by including some form of intermittent contact or interrupter in the aerial circuit in conjunction with a detector of any ordinary type. In this case, the energy in the aerial circuit will pass on to the detector only during those periods when the circuit is closed by the interrupter, but will be lost as far as the receiver is concerned during the remaining intervals. The efficiency of the arrangement will depend upon the relative duration of the open and closed contact periods, but will seldom exceed 50 per cent., and will often be lower. In a sense, however, the modulation by this method may be said to be complete, as the actual energy flowing to the detector varies between zero and the maximum possible value. The arrangement in which the interrupter or "tikker" is included in the telephone circuit—*i.e.*, the detector output circuit—gives, however, better results, since the energy received during the periods when the contact is open need not then be lost, but can be stored up in an appropriate shunt condenser ready for discharge through the telephones, and utilisation therein as soon as the contact closes again.

In the case of heterodyne reception in any of its well-known forms, the modulation of the incoming oscillations is effected by means of the local heterodyne oscillations, which are adjusted to have nearly the same frequency as the signal to be received. The percentage modulation may vary within wide limits depending upon the relative intensities of the signal and the local heretodyne oscillations. The modulated or heterodyned oscillations, have, however, to pass through the detector, and it is here that considerable loss occurs. If the detector were an ideally perfect rectifier, all the semi-oscillations of one sign would pass through it, and all the other half waves would be suppressed, so that the amplitude of the rectified current would be proportional to that of the oscillations applied to the detector. However, in most practical forms of detector—including the ordinary three-electrode

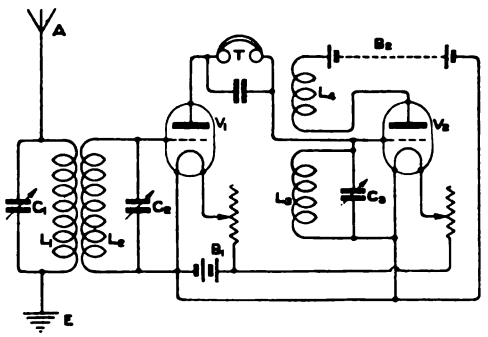
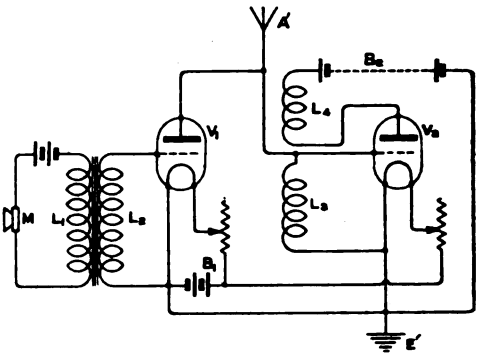



*Fig.* 1.

valve—the output is by no means directly proportional to the input, but falls off more rapidly than the applied input especially for small values of the input. In other words, if we have a given signal effect from a given oscillation source, if the strength of the received oscillation is reduced to one-half of its initial value, the output of the detector will fall off not to one-half, but more nearly to one-quarter of what it was originally. Hence, for very weak signals the ordinary detector becomes very inefficient. The output of an oscillating valve, or autodyne receiver, does not fall off quite so rapidly as does that of a simple detector valve, and this advantage is shared to the same extent by a properly designed heterodyne receiver. One of the main reasons for this improvement is due to the increased




*Fig*, 2.

energy provided by the local oscillations for the detector to handle. The total current passing through the detector can be adjusted by altering the strength of the heterodyne, so that the detector operates at or near its most effective working point

Bearing in mind, however, what has been stated above with regard to the "modulation" of the signal oscillations, the question may be raised as to whether it is not possible to apply some of the more usual modulation circuits to the receiving apparatus. R. Jouaust in a recent communication to the French Academy of Sciences has pointed out that this may be done, and has stated that remarkably good results are obtainable. In any arrangement of this sort, a detector valve is no longer required, but the incoming signals are caused to modulate the output of a separate oscillating valve—much in the same way as the microphone is used to modulate the output of the oscillating valve of a radio-telephone transmitter. In order that the resultant modulated output may be audible in the receiving telephones, it is desirable to adjust the frequency of the oscillating valve to a value nearly the same as the incoming oscillations, so that the pulsations of the amplitude of the local oscillations at a frequency nearly equal to their own will cause "beats" to be formed which can be heard in the telephone receivers. Evidently to make use of this idea, many types of circuit are possible, since the modulation can be applied to the oscillating valve in a number of ways. In Fig. 1 is illustrated diagrammatically one such method—the incoming signal oscillations being employed to control a modulator valve which acts as an absorption shunt to the oscillation circuit of the local oscillator valve. The telephones T in that diagram are shown in series with the plate circuit of the modulator valve, so that they are influenced by the current shunted off from the oscillator.

The receiving aerial circuit A, $L_1$, $C_1$, E, is provided with the usual tuning and coupling arrangements for passing the incoming energy on to a tuned secondary circuit $L_2$ $C_2$, in the usual manner.

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In place of joining the usual detector valve across the secondary circuit $L_2C_2$—or alternatively across the aerial circuit $L_3 C_3$ by direct connection—the grid and filament of the *modulator valve* $V_1$ are similarly connected. The local oscillator valve $V_2$ is provided with the usual oscillation circuits for generating oscillations in the closed circuit $L_3 C_3$ by the reaction coil $L_4$ connected in the anode circuit of this valve. The plate-filament circuit of the modulator valve $V_1$ is connected across this oscillation circuit $L_3 C_3$ of the valve $V_2$, so that the plate-filament path of the valve $V_1$ acts as a shunt of variable impedance across the oscillation circuit, $L_3 C_3$, thus controlling the amplitude of the locally generated oscillations. The telephones T should be shunted by a small by-pass condenser, since the currents drawn off or absorbed by the modulator valve are radio-frequency ones from the oscillatory circuit $L_3 C_3$.

The similarity of this arrangement to the shunt or absorption control method for a radio-telephone transmitter may be brought out by comparing Fig. 1 with Fig. 2, which shows the connections for the transmitter, the modulator valve $V_1$ here being controlled by the microphone M, and the output of the oscillator valve $V_2$ being applied to the aerial circuit A′ E′ instead of to the telephones T (Fig. 1) In both cases both valves can be fed from the common L.T. battery $B_1$, while the H.T. source $P_2$ is connected in the plate circuit of the oscillator valve only.

Some experiments on these lines that have been carried out by the writer, have shown that the method can quite easily be given the same order of sensitiveness as is possessed by the more usual detector arrangements, while doubtless a better arrangement of the apparatus would give improved results. It has in fact been claimed by Jouaust that by this method, used in conjunction with two high-frequency amplifying valves, it is possible in Paris to read signals from Annapolis using as a frame aerial a square coil of wire of 8 ins. side by 4 ins. long, and that the results obtained are much superior to those possible with ordinary apparatus.

In order to experiment with the method, any convenient separate heterodyne oscillator may be used for the valve $V_2$ (Fig. 1) and its associated circuits, and the modulator valve can be joined across the tuning condenser of the heterodyne in the manner indicated. It is convenient sometimes to add a potentiometer in the grid circuit of the modulator valve $V_1$, so as to control its absorption effect on the oscillation valve. Experiments show that as a rule no improvement of the arrangement is made by adding a D.C. voltage into the plate circuit of the modulator valve in addition to the H.F. voltage applied by the oscillator valve $V_2$, thus showing that the valve is functioning truly as a modulator rather than as a detector valve.

Evidently the modulation effect can be applied to the oscillator in many different ways, but these may not all be equally effective for receiving purposes, just as their operation as transmitters varies with the conditions of use. Further experiments on these lines are in progress, the results of which may be published at a later date.

# The Writtle Transmissions

IT is really only a matter of a few weeks since the introduction of the first officially recognised transmissions for amateurs in this country, and yet already the Tuesday evening telephony and transmission of calibration waves is looked forward to as an established feature in the amateur programme.

From the numerous reports on the reception of these transmissions which we have received, it would appear that the reception is good in almost every part of the country, and the transmissions, particularly the telephony, is very much looked forward to.

The Marconi Scientific Instrument Company, in their transmission of telephony on Tuesday, April 11th, gave some interesting information regarding the station and also notes on the reception in different parts of the country obtained from letters received from amateurs. For the information of those who did not record these remarks, we give below some of the more interesting of the observations transmitted.

The speaker at the Writtle Station announced that many hundreds of reports on their transmissions had been received, and that only a few would be quoted. An observer at an aerodrome over 100 miles distant from the transmitting station wrote that "out of all the telephony I have heard, both service and commercial, it is by far the best and most clear." Mr. G. W. Benzie, of Peterculter, Aberdeenshire, reported that he could follow the music with telephones on the table using three valves, and Mr. J. A. Crombie, of Guthrie, Forfarshire, using an amateur-built five-valve set, gets the music and speech in a loud speaker audible all over the room. It is interesting to note that some careful observers in Edinburgh have difficulty in getting the telephony and report that a fading off is marked. Those responsible for the transmissions state that the aerial amperage during transmission remains practically constant throughout, and, in consequence, they attribute this fading to local conditions in the Edinburgh district, and invite further reports and observations from that district in particular. In the Liverpool district the telephony is well received with a single valve set, though some jamming from Seaforth is experienced. Two of the most interesting reports of reception which were announced are those of Messrs. S. Lowley, of Liverpool, and C. Bain, of Newcastle-on-Tyne, the former reporting clear reception of the telephony on a four-wire indoor 12-ft. aerial, using a three-valve receiver, and the latter reporting that music is audible three feet from the telephones using an indoor aerial 25 ft. long, and a four-valve receiver, using two high frequency amplifying valves.

The accompanying photographs will be of interest as showing the aerial and apparatus used in the transmissions.

Fig. 1 shows the aerial at Writtle, the dimensions of which are 200 ft. long and 110 ft. high, the aerial

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*Fig. 1. The aerial used for the* **2MT** *transmissions.*

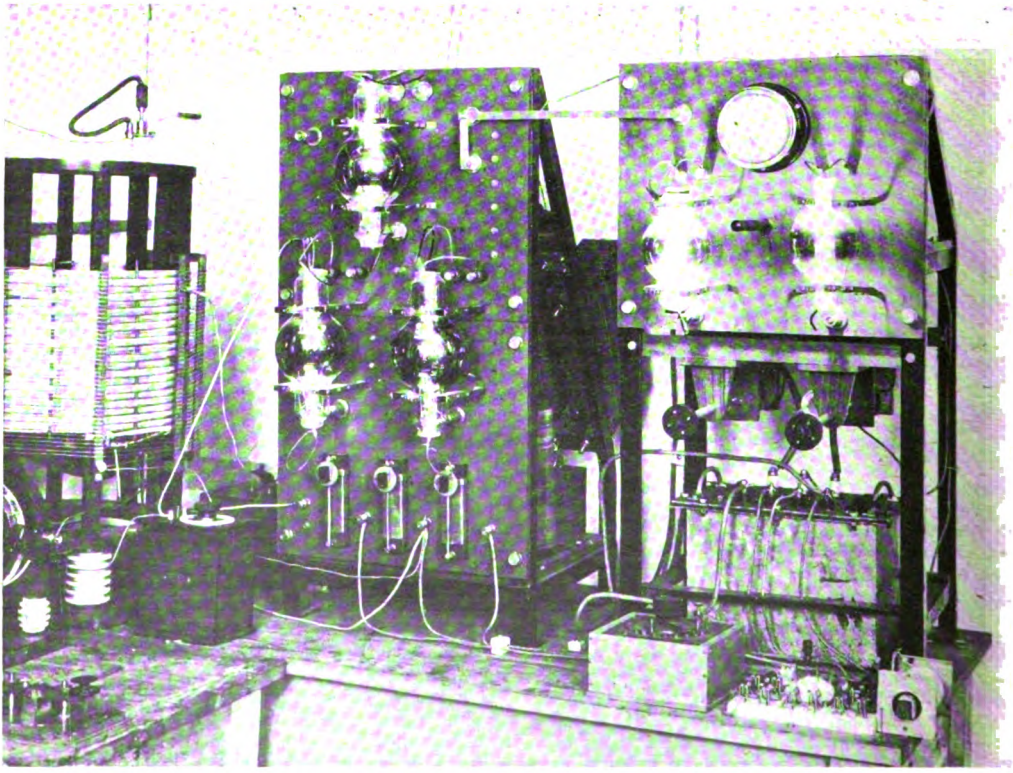

*Fig. 2. The transmitting apparatus of* **2MT.**

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being of the inverted "L" type, employing four wires.

Fig. 2 shows the transmitter, including the rectifier valves, choke control being used in modulation. It is hoped to give a fuller account of the station at a later date.

The organisers of the transmissions notify us that they hope a change in wavelength may be effected at a later date in order to overcome some of the jamming which most of the reports received indicate gives a good deal of trouble. In this connection they suggest that frame aerials might be used to a greater extent by those who are able to employ several valves in their reception, and that perhaps some useful experimental work might also be done in the direction of eliminating interference by the execution of suitably directed aerials.

# An Amateur Station in Chester

By J. C. Walker.

A YEAR ago I decided to re-erect the wireless installation which I had at my house prior to the war. I decided to make a single valve set of simple design and had no intention of constructing a large station or spending much time on it, but the accompanying photographs and description will show how resolutions can so easily be broken when one gets really keen.

I will spend no time in giving details of all the various circuits and instruments I have made and scrapped before I considered my set was, in my opinion, nearly perfect, but will start now on a description of my present station.

The aerial is a twin wire phosphor bronze 70 feet long from the free end to the instruments spaced for 54 feet of its length by two 7 ft. 6 in. ash spreaders. The free end is 54 feet high and the lead-in end is 34 feet high. The tallest mast is fixed to a 10 ft. baulk of oak, sunk five feet into the ground on a cement bed, and is so arranged that four men can lower the mast in a few minutes by means of a block and tackle. Except for slight screening near the lead-in the aerial is well clear of all trees and roofs. The earth is to a water pipe conveniently situated in the instrument room.

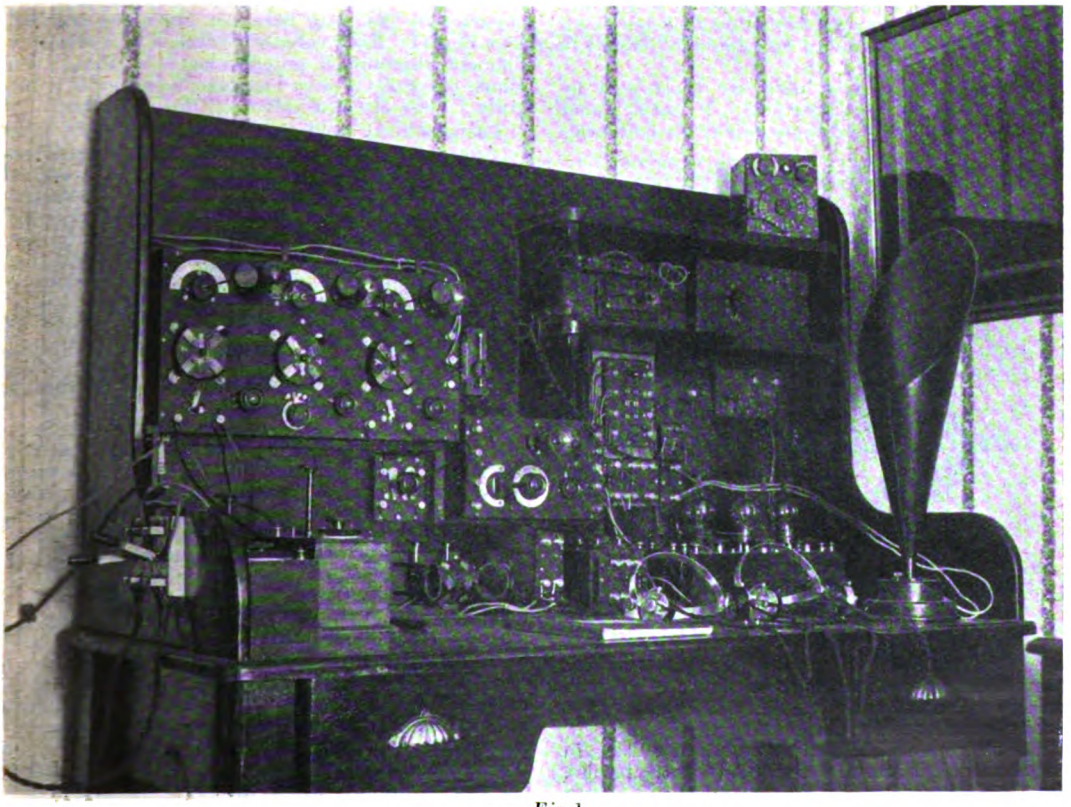

*Fig* 1.

The set itself is easily explained by a glance at the diagram of connections.

Tuning is done entirely by honeycomb coils.

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The first few honeycombs used were home-made and gave very good results, but to make a neat job of them took so much time that I considered it cheaper in the long run to buy them.

My formers were made of 2 in. diameter hard wood, 1¼ in. wide, 32 holes being drilled equally round each side to take thin crochet needles, the method of winding following that described in a back number of *The Wireless World*. I found that to get a pure honeycomb formation took me about five minutes a layer and a considerable amount of patience.

The honeycombs now used are those sold by Messrs. Ashleys, of Liverpool. I have about twenty of them and find that some of the coils have to be duplicated for best results for some stations, using them as a loose coupled tuner. The two tuning condensers are of 0·001 mfd., shunted by a vernier condenser for fine tuning.

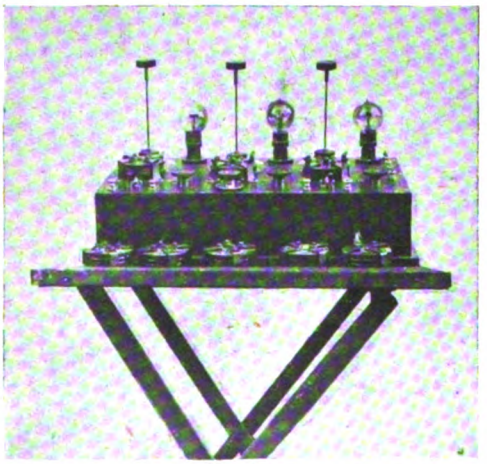

*Fig.* 3.

The three valve H.F. amplifier has now been in use about eight months and gives good results. The transformers used were purchased, but extra valve sockets have recently been fitted to use transformers of my own make, having four valve pins fitted. A 4-point rotary switch is so wired that either none, one, two or three valves for high frequency amplification can be used, pulling out the transformer which is not required, breaking off the circuit of the unused valve. This I find useful since one does not require to use all three valves on high power stations.

Transformers wound to the following wavelengths are used: 400, 600, 1,000, 2,000, 5,000, 8,000, 10,000 and 13,000, and more are in course of construction.

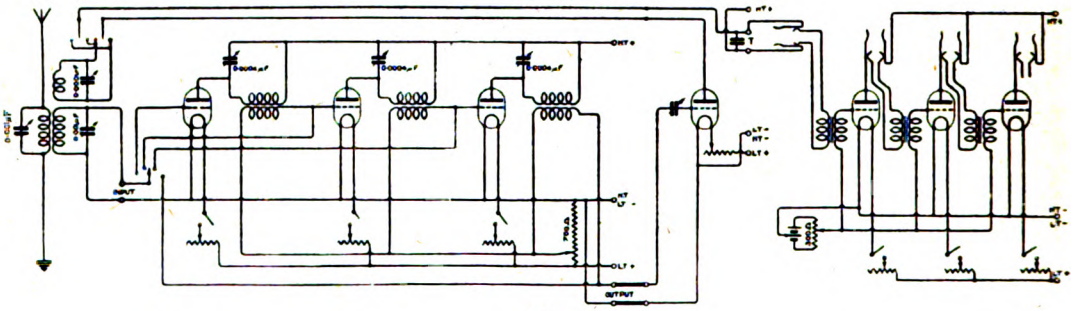

*Fig* 2.

Three variable condensers are shunted across the primaries of the transformers. These condensers are fitted with long ebonite handles so that the capacity of the body does not upset the setting. (See Fig. 3). Each valve is controlled by a separate filament rheostat, a potentiometer of about 600 ohms, external to the instrument controlling the grids. I use Mullard valves on this amplifier.

The amplified oscillations are next brought to a separate unit, which is purely and simply a rectifier. This instrument can be used by itself as a single valve receiver and comprises reaction condenser, filament resistance, valve socket, grid leak, variable grid condenser of 0·004 mfd., telephone condenser and necessary terminals. Interposed between this rectifying unit and the 3-valve low frequency amplifier is a jack, mounted in a box with four terminals. All the telephones have plugs fitted to them, therefore it is quite an easy matter to plug in either the head telephones or loud speaker after the first four valves and thereby breaking the circuit to the low frequency amplifier.

The 3-valve low frequency amplifier follows standard practice. All the three transformers are spaced out as far as possible in the instrument, each valve has a separate rheostat and jacks are fitted so that either one, two, or three valves can be used at will. A potentiometer and local cells of 3 volts control the grids. Marconi "R" valves are used with this instrument. This instrument can be seen in the right-hand bottom corner of the table (see Fig. 1).

Since this amplifier works so quietly I have just constructed an extra stage so as to bring in concerts even louder than before. This comprises a separate unit (not in Fig. 1), having a Federal transformer, two valves in parallel, to cope with the heavy current, rheostat and switch.

The loud speaker is of 4,000 ohms. resistance, one pair of head telephones are of 120 ohms and are of the adjustable type (Brown's), used with a transformer, the others are Brown's A type, 2,000 ohms, which I find are slightly better for telephony.

Two H.T. batteries are used, one of 45-60 volts for the H.F. amplifier and rectifier; 75 volts on the L.F. amplifier, Siemen's 15 volt units being used.

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A reversing switch is fitted in the reactance circuit (magnetic reactance being used). Three 6-volt, 100 amp. hour accumulators are used for the valves, these being kept continually charged on the premises.

All instruments are mounted on matt finished ebonite and the panels are fitted on to polished mahogany boxes, every terminal and screw-head is nickel plated, so giving the set a very pleasing finish. The table and some of the instrument boxes were specially made for me, otherwise all the rest, with the exception of coils, transformers and some variable condensers, were home-made in my own workshop.

Although the photographs were only taken a few weeks ago, many detailed improvements have been made, the tuning condensers have been mounted in a more convenient position (they can be seen in the bottom left corner of the table), and wiring has been much simplified.

Results with this set are good. **2MT** is excellent. Annapolis, New Jersey, etc., come in well. **PCGG** has been heard down in the garden 40 yards away from the set. Mr. Burnham and Mr. Wm. Le Queux have been heard, and the Sheffield, Manchester and Halifax amateurs come in loud. Paris, with her afternoon telephony, is good, but I have yet to wind some H.F. transformers to her wavelength for best results. All European stations come in well, in fact there is a regular "farmyard" on every wavelength.

I have omitted to go into a detailed construction of my set, but if anyone should care to know anything further about the various instruments I will be pleased to furnish particulars if they apply in writing to me at 9, Curzon Park, Chester, where my station is situated.

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# A Detachable "Pin-Type" Resistance Capacity Coupling for H.F. Amplifiers

By H. C. EVANS, M.Sc.

ONE of the disadvantages of the invaluable "pin-type" interchangeable H.F. transformers, now so commonly used in H.F. amplifiers, is the expense of winding them for the higher wavelength ranges. This expense is unnecessary for wavelengths above 2,000 metres if the ordinary resistance-capacity coupling can be quickly substituted for that of the transformer, as it is well known that there is little to choose between the two methods on the higher range of wavelengths.

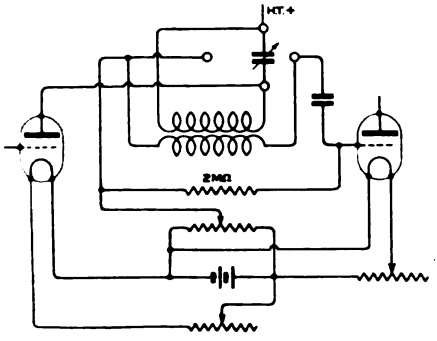


*Fig.* 1.

The writer has found the following pin-type high-resistance-capacity coupling very efficient when used in conjunction with a one-valve H.F. set having grid condenser and leak attached to a second detector valve. The coupling between these two valves is as shown, when using transformer.

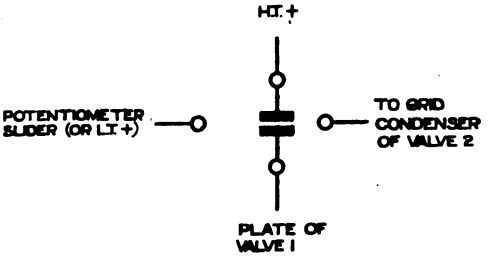


*Fig.* 2 (*a*).

The ordinary internal connections for an interchangeable transformer are as shown in Fig. 2*a*.

An ordinary valve holder or better a small oblong piece of ebonite having four valve pins attached can be substituted for the transformer Fig. 2*b*, as shown in Fig. 2*c*.

Connected across the "filament" or "primary" pins is a 50,000 ohms anode resistance, and the pin nearest to the plate of valve 1 is connected to the "grid" pin. It will be observed that the pin which in the transformer was connected to the potentiometer slider (or L.T.+) is now idle, but this is of no importance as the grid of No. 2 valve is still connected to the potentiometer (or L.T.+) through the grid-leak.

The variable condenser which was across the primary of the transformer now serves a useful

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purpose in giving greater effect to the variations in potential across the high resistance.

In sets having no grid-leaks and grid-condensers, and also in coupling up a *series* of H.F. amplifying

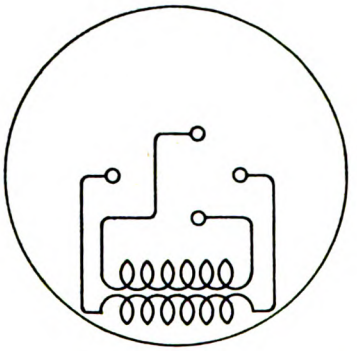


*Fig.* 2 (b).

valves, it will, of course, be necessary to substitute a small capacity for the direct connection between "grid" pin and "filament" pin of Fig. 2*c*. As a matter of fact the tuning condenser usually employed for the primary of the transformer can

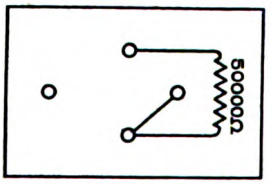



*Fig.* 2 (c).

be placed across these two points in the set, and would then serve for both purposes (Fig. 3*a*).

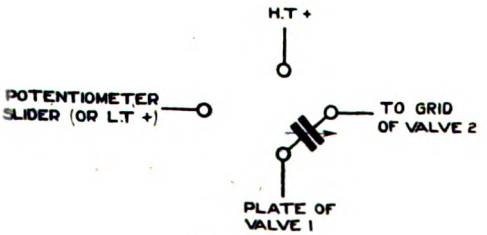



*Fig.* 3 (a).

Then for rapidly converting from transformer to high resistance amplification it is only necessary to have a resistance of 50,000 ohms and a grid-leak of 2 megohms mounted as in Fig. 3*b*. This applies when the internal connections of the set are as in Fig. 3*a*.

Finally, a perfectly safe arrangement which will give satisfaction either between H.F. valves or between H.F. Valve and Detector on all ordinary sets, whether internally connected as in Fig. 2*a* or Fig. 3*a*, is a combined resistance-capacity and grid-leak on the detachable unit as in Fig. 4.

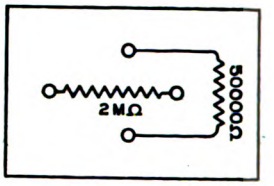



*Fig.* 3 (b).

The whole can be mounted on a piece of ebonite of about 2 ins. by 1 in., and forms a very useful adjunct to a transformer H.F. amplifier set. It is of great use for experimental purposes for rapidly comparing the efficiency of the different resistances, grid-leaks, etc., for different wavelengths and signal strengths.

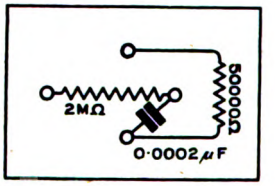
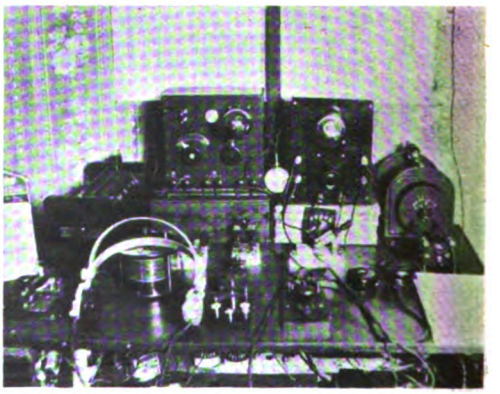



*Fig.* 4.

The idea is, of course, capable of extension to impedance-capacity amplification. For relative tests on this subject small terminals could be mounted to facilitate interchanges.

## Experimental Station



*Station of Mr. George E. Basham at Bush Hill Park, N.*

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# A Method for the Measurement of R.F. Resistances*

By Prof. P. O. PEDERSEN.

## Introduction.

THE exact measurement of radio-frequency resistance is still a rather difficult problem although the development of convenient generators of continuous waves has considerably diminished these difficulties.

The older methods† were nearly all based on the fundamental investigations of V. Bjerknes ‡ on resonance in simple and coupled circuits. These old measurements were often carried out in the following manner:—Spark discharges were produced in the circuit under test and the resulting oscillations were investigated by means of a separate auxiliary circuit loosely coupled to and in resonance with the test circuit. The measurements in connection with the auxiliary circuit were mostly carried out by means of a quadrant electrometer, the deflection of this being proportional to the time integral of the square of the potential difference.

With regard to the more modern methods I may refer to a paper of J. H. Dellinger.§ This paper also treats some of the difficulties met with in these measurements.

It would in several respects be of great advantage to have to do with only one single circuit, viz., the circuit to be tested. All difficulties connected with the tuning and the coupling would, in this way, be eliminated.

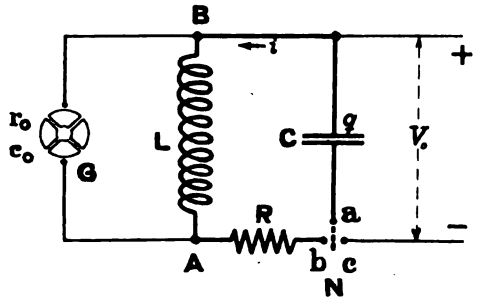


*Fig. 1. Simple Diagram of Connections.*

Of methods working along these lines we shall later on mention one or two, but before doing so, we shall very briefly consider the oscillations of the circuit shown in heavy lines in Fig. 1. Using the symbols of Fig. 1 the current will be given by

$$i = \frac{V_0}{\sqrt{\frac{L}{C} - \frac{R^2}{4}}} \epsilon^{-Rt/2L} \sin\left(t\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}\right) \quad . . (1)$$

or very nearly by

$$i = V_0\sqrt{\frac{C}{L}}\,\epsilon^{-Rt/2L} \sin \frac{t}{\sqrt{LC}} \quad . . . . . (1a)$$

This current is shown in Fig. 2, and with the symbols used there we have—

$$\frac{a_1}{a_2} = \epsilon^{\frac{1}{2}\pi R\sqrt{C/L}} \quad \text{or } R = \frac{2}{\pi}\sqrt{\frac{L}{C}} \log \frac{a_1}{a_2} \quad . . (2)$$

The values of $L$, $C$ and the ratio $a_1/a_2$ being known the radio frequency resistance $R$ may be calculated from equation (2). This principle has been used by E. Rutherford ‖ and J. Zenneck.¶ The first-mentioned author used magnetised steel needles, the last mentioned a Braun tube. Both

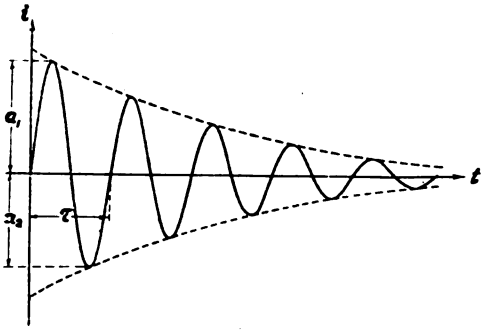


*Fig. 2. Oscillating Current Curve.*

methods are beautiful in principle but rather complicated, and they can hardly be used in connection with feebly damped circuits.

## 1.—Method.

The method treated of in the following is similar to that used by V. Bjerknes and his pupils**, in so far as both use a quadrant electrometer giving deflections proportional to the time integral of the square of the potential difference. But in our method this quadrant electrometer is connected directly to the circuit under test—see Figs. 1, 3 and 4—and not to a separate circuit, loosely coupled to the test circuit.

We shall now consider the arrangement shown in Fig. 1. The condenser C at present supposed to be without leakage, is charged to the p.d. $V_0$ when the key N is in the position ac. And when the key is then depressed to the position ab the condenser is discharged through the circuit shown in heavy lines, and containing the coil L, having a radio-frequency resistance $R$.

* Received December 28, 1921.

† E. Nesper: Die Frequenzmesser und Dämpfungsmesser der Strahlentelegraphie, p. 165-238, Leipzig, 1907.

‡ V. Bjerknes: Dampfung schneller electrischer Schwingungen (*Wiedmann's Annalen*, 44, p. 74, 1891). Ueber den zeitlichen Verlauf der Schwingungen im primären Hertzschen Leiter (*ibid.* 44, p. 513, 1891). Ueber electrische Resonanz (*ibid.* 55, p. 121, 1895).

§ J. H. Dellinger: The Measurement of Radio Frequency Resistance. (*Proceedings of the Institute of Radio Engineers*, 7. p. 27-60, 1919.)

‖ E. Rutherford: A Magnetic Detector of Electrical Waves, and some of its Applications. (*Transactions of the Royal Society*, Vol. 189A, p. 1, 1897.)

¶ J. Zenneck: Verfahren, um die Dämpfung electrischer Schwingungen sichtbar zu machen. (*Annalen der Physik*, 4, p. 801, 1902.)

** V. Bjerknes: *Wiedmann's Annalen* 44, p. 77, 1891.
S. Lagergren: Ueber elektrische Energieausstrahlung. Stockholm, 1902.

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The time integral $P$ of the square of the p.d. between the terminals A and B of the coil L is then given by—

$$P = \int_0^\infty \left(L \cdot \frac{di}{d}\right)^2 dt = \frac{L}{2R} V_0^2 \quad . \quad . \quad . \quad . \quad (3)$$

$$\text{or } R = \frac{L}{2P} V_0^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3a)$$

The value of $P$ may be determined by means of a quadrant electrometer, one pair of quadrants and the needle being connected to the terminal A of L, the other pair to the terminal B (see Fig 3). The throw of the electrometer will then be proportional to $P$. The determination of the ballistic constant of the electrometer will be discussed later on*.

The values of $V_0$, $L$ and $P$ being known, the value of $R$ is determined by means of (3a).

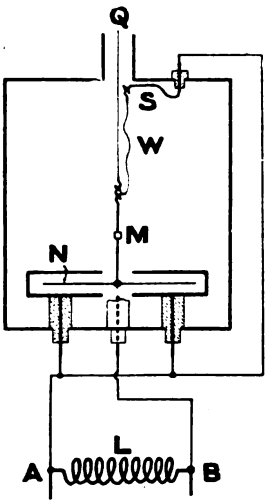


*Fig. 3. Quadrant Electrometer with Connections.*

If $V_0$ and $L$ are kept constant and an extra resistance $r$ is inserted in the circuit and the corresponding value of $P$ denoted by $P'$, we have

$$R + r = \frac{L}{2P'} V_0^2.$$

From this equation and (3a) we get

$$\frac{R+r}{R} = \frac{P}{P'}, \text{ or } R = r\frac{P'}{P-P'} \quad . \quad . \quad (4)$$

By measurement of the two electrometer throws corresponding to $R$ and $R + r$ respectively, the value of $R$ can be calculated from (4), provided, of course, that the p.d. $V_0$ is the same in both cases.

*V. Bierknes and S. Lagergren used a quadrant electrometer of which one pair of quadrants was removed, the needle being insulated and each one of the two wires from the circuit under test connected to one of the two remaining quadrants. In this case it is not necessary that the suspension wire should be conducting. We were, however, unable in this way to obtain a sufficiently high sensitiveness, and at the same time a sufficiently high stability.

## 2.—Investigation of the possible Sources of Errors.

If the condenser is *leaky* it will lose some of its charge in the interval between the breaking of the contact at c and the closing of the contact at b (see Fig. 1). The error introduced in this way may be rather serious if the said interval is not *very* short, and it will be shown later on that there are some particular difficulties which prevent this interval from being reduced with certainty, below, say, 0·01 second. But happily it is possible to eliminate this error altogether, or at least to reduce it to a quite insignificant amount by means of the arrangement shown in Fig. 4. The leads from the

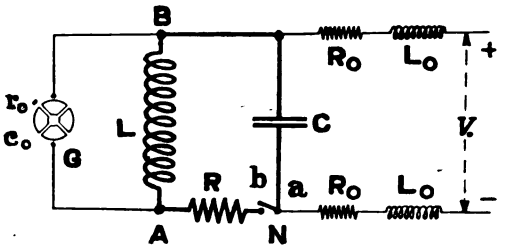


*Fig. 4. Diagram of Connections for use with a Leaky Condenser. The choke coils $L_0$ and resistances $R_0$ keep the oscillations from the leads.*

source of e.m.f. are both connected permanently to the terminals of the condenser C, and in the leads are inserted two large resistances $R_0$ and choke coils $L_0$. The resistances $R_0$ should be large, for example, between 0·01 and 1 megohm, but on the other hand $R_0$ must be very small compared with the insulation resistance of the condenser. There is generally no difficulty in complying with both conditions.

In this way the error caused by the leaking of the condenser is eliminated but another error is introduced as a continuous current will flow through the coil L as long as the key N is closed, and this current will give a p.d. of $V_0 r'/2R_0$ between A and B, $r'$ being the continuous current resistance of L. This error is, however, altogether insignificant. For instance, if $V_0 = 400$ volts, $r' = 1$ ohm, $R_0 = 10{,}000$ ohms, and if the key is closed for 5 seconds,

$$p = (\text{p.d.})^2 \times \text{time} = 2 \times 10^{-3} \text{ (volts)}^2 \text{ sec.}$$

We shall see later on that the corresponding value of $P$ will be about

$$P = 100 \text{ (volts)}^2 \cdot \text{sec.}$$

The value of $p$ is therefore negligible compared with that of $P$.

In the derivation of equation (3) we only considered the self-inductance of coil L and neglected its effective *resistance*. It is easily shown that the error thereby committed is insignificant.

The resistance $r_0$ in the lead to the needle of the electrometer in conjunction with the capacity $c_0$ between the needle and the pair of quadrants to which it is not connected, may introduce appreciable errors in two ways:—

(1) By absorbing power from the oscillating circuit and thereby increasing its effective resistance.

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(2) By reducing the p.d. between the needle and the opposing pair of quadrants.

We shall consider both of these possible sources of errors.

(1) If the p.d. across the condenser at a certain moment is $V$, the average loss $\Delta W$ of electrical energy in the element of time $\Delta t$ will be

$$\Delta W = \tfrac{1}{2} V^2 \frac{C}{L} R \Delta t.$$

The corresponding loss in the lead to the needle will be

$$\Delta w = \tfrac{1}{2} V^2 \frac{c_0^2}{CL} r_0 \Delta t.$$

Therefore,

$$\frac{\Delta w}{\Delta W} = \frac{c_0^2}{C^2} \cdot \frac{r_0}{R} \quad . \quad . \quad . \quad . \quad . \quad (5)$$

On the other hand equations (5) and (6) show that the resistance $r_0$ ought not to be too large, but if the suspension wire is rather short and stout, the sensitivity of the electrometer will be too small. We tried the usual remedy for this trouble—viz., to let a wire hanging down from the needle dip in sulphuric acid but without success. The arrangement shown in Fig. 3 proved, however, satisfactory. The needle N is suspended on a quartz wire Q while the electrical connection is made by means of the Wollaston wire W, connecting the stout copper wire S with the stem of the needle. The core of the Wollaston wire consists of a platinum wire 0·007 mm in diameter, but the silver coating has been left at both ends of W and these ends serve as hooks connecting W with the wire S and with the stem of the needle. The resistance of W in the electrometer actually used was about 180 ohms.

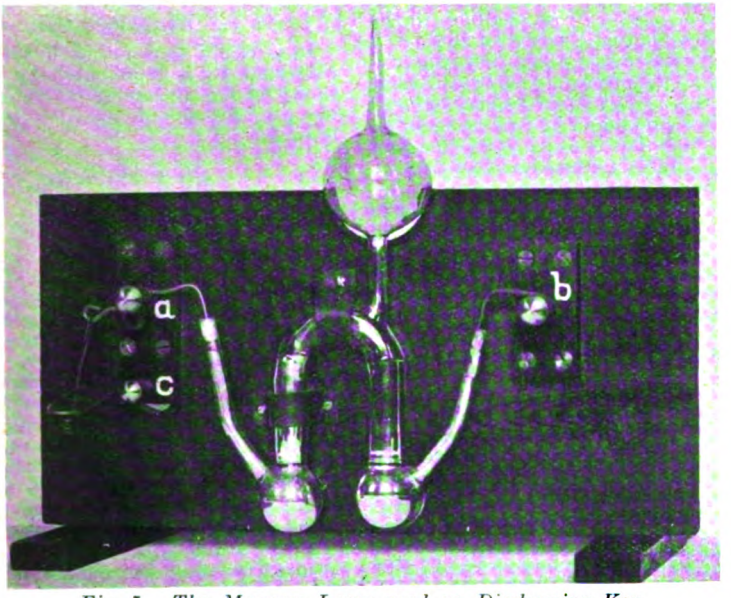


*Fig. 5. The Mercury Lamp used as Discharging Key.*

Examples :—

If $c_0 = 5$ cm, $C = 10{,}000$ cm, $r_0 = 180$ ohms, $R = 0{\cdot}6$ ohms, then

$$\frac{\Delta w}{\Delta W} = 7{\cdot}5 \times 10^{-5}$$

If $C = 500$ cm and the other constants remain unaltered we get $\frac{\Delta w}{\Delta W} = 0{\cdot}03$.

This error is therefore in most cases negligible.

(2) The ratio, $\eta$, of the loss of p.d. in the lead to the total p.d. across the condenser is given by

$$\eta = \frac{c_0}{\sqrt{CL}} r_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Example : If $\frac{1}{\sqrt{LC}} = 10^6$, $c_0 = 5$ cm, $r_0 = 180$ ohms, then $\eta = 0{\cdot}001$.

### 3.—The Discharging Key.

There remains still one source of error to be considered, viz., the energy lost in the discharge key in making the connection ab (Figs. 1 and 4). It became immediately evident that the key question was a very difficult one. We first tried a well cleaned and well polished ordinary discharge key, but the throws of the electrometer obtained in this way were very much too small and extremely capricious. We may, for instance, quote the following set of consecutive readings, 19, 5, 7, 12. It was later ascertained that the readings ought to have been about 105.

There could be little doubt that this error was due to the minute spark which appears at contact b when the circuit CL is closed at that point. We therefore tried a number of contact-making arrangements, such as polished copper, and steel hammers making contact with polished copper or steel plates, the impact being made with great

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velocity. The said hammers and plates were carefully rubbed over with *clean* emery paper. None of these methods where the contact was made between pieces of solid metal proved successful. We then tried contact-making between a very clean surface of mercury and clean stout wires of steel, tungsten, or platinum. In this case the throws were large and constant, provided that after every contact-making the surface of the mercury was renewed and the wire carefully cleaned with clean emery paper.

We next tried to let the contact-making take place between two masses of mercury in vacuum, the apparatus used being the mercury lamp shown in Fig. 5. The terminals abc in Fig. 5 are identical with abc in Figs. 1 and 4. The contact-making is effected simply by tilting the lamp sufficiently, a jet of mercury then passes from one limb to the other. The cross-section and length of this jet is not exactly the same every time, but the uncertainty resulting herefrom is always below 0·005 ohm, and this value may be further reduced by altering the construction of the mercury lamp. The resistance of this key is about 0·01 ohm and is in the following included in the effective resistance of the circuit.

*With this key the throws of the electrometer were large and remarkably constant* as will be proved later on.

No light is seen in the lamp at the contact-making but the further discussion of the physical nature of the key difficulties must be postponed to a later occasion.

## 4.—Determinations of the Ballistic Constant of the Electrometer.

In order to obtain the ballistic constant of the electrometer we have used the arrangement sketched in Fig. 6. $R_1$ is a large resistance with very little self-inductance $L_1$ and with a very small capacity $c_1$. A well-insulated mica condenser $C_1$ is by means of the key N charged to the p.d. $V_1$, and afterwards discharged through the resistance $R_1$. The time integral of the square of the p.d. between the terminals A and B of $R_1$ is then measured by the throw of the electrometer G.

The value, $B$, of this time integral is easily calculated if we neglect, for the present, the capacity $c_1$ of the resistance $R_1$.

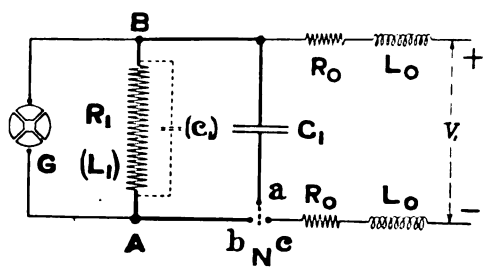


*Fig. 6. Diagram of Connections used in order to obtain the Ballistic Constant of the Electrometer.*

The instantaneous value of the p.d. across the condenser $C_1$ is denoted by $v_1$ and we use the following abbreviations:—

$$K_1 = \frac{R_1}{2L_1} \quad \text{and} \quad h_1^2 = \frac{1}{L_1C_1}$$

We have then

$$v_1 = \frac{V_1}{2\sqrt{K_1^2 - h_1^2}}\left\{\left(K_1 - \sqrt{K_1^2 - h_1^2}\right)\epsilon^{-\left(K_1 + \sqrt{K_1^2 - h_1^2}\right)t} + \left(-K_1 + \sqrt{K_1^2 - h_1^2}\right)\epsilon^{-\left(K_1 + \sqrt{K_1^2 - h_1^2}\right)t}\right\} \quad (7)$$

and

$$B = \int_0^\infty v_1^2 dt = \tfrac{1}{2}V_1^2\left(R_1C_1 + \frac{L_1}{R_1}\right) \quad . \quad . \quad . \quad (8)$$

The last term on the right hand is generally extremely small in comparison with the first term. We may therefore use the following approximation

$$B = \tfrac{1}{2}V_1^2R_1C_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad (8a)$$

It is easily shown that if the capacity of the resistance $R_1$ is represented by a capacity $c_1$ (as shown in Fig. 6) having no resistance in its leads, we get instead of equation (8a) the following formula:—

$$B_1 = \tfrac{1}{2}V_1^2R_1\frac{C_1^2}{C_1 + c_1} \quad . \quad . \quad . \quad . \quad (9)$$

The ratio

$$\frac{B_1}{B} = \frac{C_1}{C_1 + c_1} \quad . \quad . \quad . \quad . \quad . \quad (10)$$

will with good resistances be very nearly equal to 1.

In this case we also meet with some key difficulties of the same nature as those treated of above, but they are not so serious here, and they may be overcome in the same way, namely, by using as key the mercury lamp shown in Fig. 5. When the lamp is tilted the connection between a and c (see Fig. 6) is broken automatically by means of the copper wires shown to the left of Fig. 5.

With this key and for p.d.'s up to at least 440 volts—greater p.d.'s have not been tried—the throws of the electrometer are fairly constant, and the arrangement shown in Fig. 6 may then be used for the determination of the ballistic constant of the electrometer. We need only calculate the time integral $B$ according to formula (8a) and measure the corresponding throw $S$, the ballistic constant $\beta$ is then determined by—

$$B = \beta S \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

## 5.– Tests.

We first ascertained that the ballistic constant $\beta$ was independent of the throw. To this end we used a Helmholtz pendulum which for $T$ seconds connected a p.d. of $V$ volts to the terminals of the quadrant electrometer. $T$ was kept constant and $V$ altered within wide limits. There was a very nearly straight line relation between $TV^2$ and the throw.

We then made a series of measurements on a circuit having a coil with a self-inductance $L = 1{\cdot}345 \times 10^{-3}$ H, and a capacity of about 20,000 cm (air condensers). Using the arrangement shown in Fig. 4 we first investigated the proportionality of the throw to the square of p.d. The results are given in Table I.

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TABLE I.

| Voltage $V$. Volts. | Throw $S$(observed). mm | Throw $S$(calculated) mm | $S_{(cal.)} - S_{(obs.)}$. mm |
|---|---|---|---|
| 440 | 107·3 | 107·3 | 0·0 |
| 220 | 27·0 | 26·8 | − 0·2 |
| 110 | 5·9 | 6·6 | + 0·7 |

The difference between the observed values and those calculated on the basis of the square law are not greater than can be accounted for as casual errors.

Another series of tests is recorded in Table II. An extra resistance, $r$, was here inserted in the circuit and the corresponding throws, $S$, measured. The value of the effective resistance, $R$, of the circuit itself was then calculated by means of formula (4).

TABLE II.

$V = 432$ volts. $L = 1{\cdot}345 \times 10^{-3}$ H.

| $r$ ohms | $S$ mm | $S_{mean}$ mm | $R$ ohms | $R - R_{mean}$ ohms | $f$ Per cent. |
|---|---|---|---|---|---|
| 0 | 102·0<br>101·9<br>101·5<br>101·4 | 101·7 | | | |
| 0·1 | 88·2<br>89·0<br>89·1<br>89·0 | 88·82 | 0·689 | + 0·006 | + 1·0 |
| 0·3 | 71·1<br>70·7<br>69·9<br>72·0 | 70·93 | 0·690 | + 0·007 | + 1·0 |
| 0·5 | 58·2<br>58·5<br>58·5<br>58·6 | 58·45 | 0·676 | − 0·007 | − 1·0 |
| 1·0 | 41·5<br>40·7<br>40·1<br>40·5 | 40·70 | 0·669 | − 0·015 | − 2·2 |
| 2·0 | 26·1<br>25·8<br>26·0<br>26·5 | 26·1 | 0·691 | + 0·008 | + 1·2 |

$R_{mean} = 0{\cdot}683$ ohms.

The close agreement between the observed and the calculated throws in Table I, and between the calculated values of $R$ in Table II seems to prove conclusively that the energy losses in the mercury-vacuum key are extremely small, and may, without appreciable errors, be neglected.

As a last check of the method, the ballistic constant $\beta$ of the electrometer was determined in the manner sketched in Fig. 6. The data were :— $V_1 = 432$ volts, $C_1 = 0{\cdot}25 \times 10^{-1}\mu$F, and $R_1 = 8{,}000$ ohms. The corresponding value of $B$ is, according to (8a)—

$$B = 186{\cdot}6 \text{ (volts)}^2\text{.sec.}$$

The throw of the electrometer was $S = 109{\cdot}5$ mm, and we have accordingly—

$$\beta = \frac{B}{S} = 1{\cdot}701$$

During the same tests the throw caused by a discharge through the oscillating circuit was equal to 108 mm. We have, accordingly,

$$\tfrac{1}{2}V^2\frac{L}{R} = \tfrac{1}{2}\,432^2\,\frac{1{\cdot}345 \times 10^{-3}}{R} = \beta.108 = 183{\cdot}6,$$

or

$$R = 0{\cdot}684 \text{ ohm.}$$

This value agrees very well with the mean value, $R = 0{\cdot}683$ ohm, found in Table II. This close agreement also indicates very strongly that the error due to the energy loss caused in the contact has been eliminated.

The ballistic constant of the electrometer being known, the effective resistance of an oscillating circuit may be determined by the measurement of one single throw, as we have

$$R = \frac{L}{2\beta S}V^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

**Conclusion.**

The main advantages of the method are :—

(1) The method is very convenient in use, being simple, reliable and quick.

(2) The method gives very accurate results as compared with other methods.

(3) The method does not demand any h.f. generator, and also completely eliminates all inconveniences and troubles in connection with tuning and coupling.

In carrying out this investigation I have been ably assisted by Mr. Chr. Nyholm, E.E.

Telegraph and Telephone Laboratory of
The Royal Technical College, Copenhagen.

## The Modern View of Electricity and the Three Electrode Valve.

We have been asked to point out the following corrections to the paper bearing the above title recently published :

On page 70, col. 2, line 4, for "other" read "ether."

On page 73, col. 1, for "an increase of plate voltage of 20·5 negative gives us a rise of about 7 M.A.," read "an increase of plate voltage of 20·5 gives us a rise of 0·7 milliamps."

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# A Single Valve Station

By N. WHITELEY.

NO doubt there are many amateur wireless enthusiasts who would like to erect their own stations, but are prevented from doing so from lack of space in which to erect an aerial out of doors, so that probably the few notes below of my experiences with an indoor aerial, together with a brief description of the apparatus I am using, will be of interest.

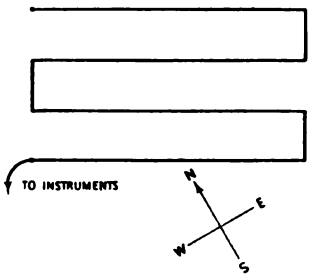


*Fig.* 1.

Fig. 1 shows the form of aerial in use. It is made of ordinary bell wire (insulated) and is stretched horizontally between two wooden beams just below the roof. There is a total length, including lead to instruments, of approximately 50 ft. and the lines of the loop are 2 ft. apart.

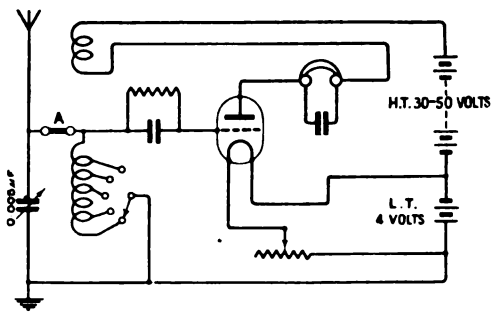


*Fig.* 2.

Fig. 2 shows the theoretical connections of the set, the master instrument of which is a short-wave tuner designed for wavelengths from 300 to 1,200 metres approximately. This instrument was made for me by Mr. W. G. A. Daniels, one of my colleagues of the Bradford Wireless Society, and it has proved very satisfactory.

The A.T.I. is a basket coil wound with No. 24 D.C.C. wire, and tappings are taken from it at five points and brought to a switch on the ebonite front panel. The tuning of the aerial circuit is completed by means of a 0·0005 mfd. variable condenser, which for short waves up to 1,200 metres is connected in series. A switch is provided, by means of which the condenser can be put in parallel when necessary.

The Reactance Coil is also of the basket type, and is wound with No. 28 D.C.C. wire, and the two leads from it are taken outside the case to facilitate changing the value of reactance for long wave. The coil is mounted on the back of the case, which is hinged so that tight or loose coupling can be obtained.

The wood of the case acts as grid leak, the grid condenser being screwed down to it.

I am at present using an "R" valve, which functions very well with 50 volts H.T. and 4 volts on the filament.

The telephones are 8,000 ohm Sullivans.

Fig. 3 gives a rough sketch of the front panel of the main instrument, the case of which is finished in mahogany, stained and polished.

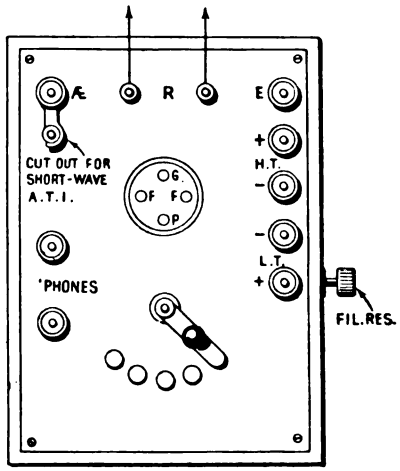


*Fig.* 3.

Fig. 4 shows a home-made "Slab Coil" tuner for long wave, and by the interchange of various coils, wavelengths from 1,200 to 20,000 metres are obtained, the 0·0005 condenser being in parallel.

As regards construction. The base is a polished wood block (recessed), such as electricians use for mounting tumbler switches, etc., and the upright "D" is a piece of polished wood curtain rod, 1 in. in diameter, with a $\frac{3}{16}$-in. hole drilled half through. Into this hole is fitted a vulcanite rod (in this case a chemical stirring rod) on which the mounted slab coils slide. "A" is the A.T.I. and "B" the Reactance, the two leads from each coil being brought down to terminals on the base.

By opening the strap marked "A" in Fig. 1, the short wave A.T.I. is disconnected. Similarly, the two S.W. reactance leads are freed and the front panel of the instrument then becomes a valve panel only, and to it the long wave tuner is connected in the usual manner.

The Slab Coils are wound with No. 36 D.S.C. wire and immersed in wax and flexible leads are connected to the two ends of each. Each coil is

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then wound with tape. The method of mounting is very simple, and is shown in Fig. 5. Discs of stiff card of suitable diameter are cut, and each disc

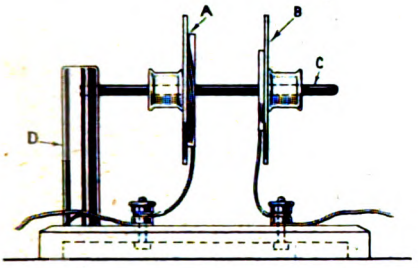


*Fig.* 4.

is glued concentrically to an ordinary wooden cotton reel, and the centre of the card is pierced to fit the rod on which the coils slide, "C." The prepared coils are attached to the card discs by means of adhesive tape. I find that this arrangement works very well.

I have been very agreeably surprised with the performance of the set. All the principal European

*Fig.* 5.

stations come in quite loud, **FL, POZ, HB, PCH** and **SAJ,** to instance a few, and Shipping comes in very well on the pure note. Telephony is not so good except from one or two local stations, but taking all factors into consideration, the apparatus has far exceeded my expectations.

# Amateur Inter-Valve Resistance Construction

By E. W. KITCHIN A,M.I.C.E.

VERY few amateurs who use circuits requiring non-inductive resistances of many thousands of ohms each, seem to care to tackle the problem of making such for themselves; and yet it is not a very difficult matter to construct an article giving results equal to those professionally made.

The writer has already described in these columns* how a piece of wet cotton can be used for this purpose, and a resistance made in such a manner functions well.

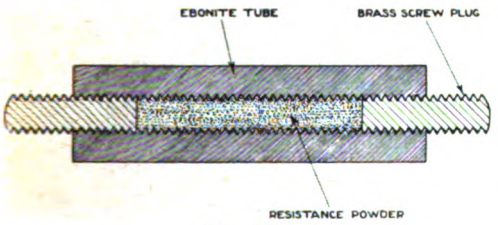


*Fig.* 1.

In response, however, to several requests, the following notes have been prepared giving details of how to construct a dry resistance of cylindrical pattern; which has obvious advantages, as its overall length need not exceed one inch.

For each resistance there will be required a piece of ebonite rod about three-quarters of an inch long; its diameter may be ¼ inch. A hole should be drilled through the rod from end to end and then tapped with No. 6 B.A. thread for ¼ inch at each end, or, if preferred, right through. Ebonite tubing can, of course, be used if of correct bore.

Two screw plugs will be needed, each about ¼ inch in length, and can be made from brass wire threaded so as to screw into the tube. The ends of the plugs which enter the tube should be filed quite flat and smooth, the other ends may be rounded to fit a depression in a spring clip.

We have now an insulating tube with a metal plug screwed in each end, and an air space separating the plugs. This space is to be filled with a powder giving the required resistance.

Now carbon is a material possessing electrical resistance, but not sufficient for the present purpose if used alone. It is therefore necessary to dilute the carbon, which will be in powder form, with some inert powder; and a convenient one is chalk, preferably the precipitated variety. Ordinary blacklead which is used for blacking stoves will furnish the carbon, and a piece of this should be carefully and lightly scraped with a knife until a sufficient quantity of powder has accumulated. This should be thoroughly dried, and the same remark applies also to the chalk.

The carbon and chalk should next be very thoroughly mixed together in the proportions of 1 part carbon to 2½ parts chalk, all lumps being crushed well. The resulting powder will be of a moderately dark grey colour, and should give a resistance in the tube of between 30,000 and 100,000 ohms. One of the plugs may now be screwed in ⅛ inch into the tube, and the tube filled with the powder, which should be rammed tight with a match; the filling and ramming process being repeated until the tube is nearly full. The second plug may then be inserted and both should then be screwed in as tight as possible, due care being observed that the ebonite tube is not split during the operation. Each plug should now project ⅛ inch, but if less than this, a little more powder should be put in, and the plug again screwed up hard.

A trial test may now be made of the filled tube, as the required resistance will probably be in the

* See *Wireless World*, July 10th, 1920.

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neighbourhood of 80,000 ohms, and some adjustment of the filling may be needed. If no means are at hand of making a quantitative test the tube may be inserted in the circuit, and tried on actual signals: if additional resistance (such as a piece of wet cotton) in parallel with the tube improves results, then the powder mixture requires a little more carbon. This can be added to the unused mixture, and the tube emptied and refilled; and by this trial-and-error method any desired value, within limits, may be given to the resistance. The correct value should be arrived at by the third trial, and the mixed powder remaining over can then be regarded as "standard," and used for filling other tubes.

It is of course an advantage if during these trials the tube can be tested for results against a professionally made resistance of the value required.

It will no doubt be recognised that it is of little use attempting to give *exact* quantities for the proportions of the powders necessary to produce a given resistance, for these would have to be different each time in accordance with the varying amount of ramming given when filling the tube: the amounts given above, however, will form a very good starting point.

Should it be desired to alter the resistance of a tube very slightly it may suffice to remove one plug and take out a little powder, or add a very little chalk, as may be needed: in the latter case the end of the powder column, which will be glazed with pressure, should be broken up with a pin and the added chalk incorporated with part of the powder already there.

It will be understood that the dimensions given above for tube and plugs can be varied if desired, any change being compensated for by altering the length of the powder column or its carbon percentage, or both.

When finally declared of the correct value the tube should have a little shellac varnish run round where brass and ebonite meet, after which it may be regarded as permanent provided the powders were quite dry before filling.

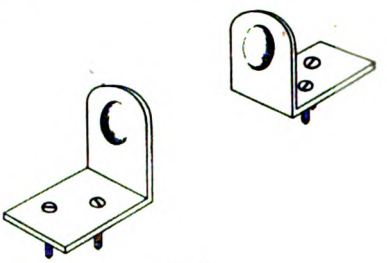

*Fig.* 2.

A convenient way to hold the tube in position in the circuit is to make two clips of thin springy brass, as shewn in Fig. 2, with a recess in each made with a round punch. The tube can then be sprung into place.

# A Simple Rotary Converter

BY E. A. PYWELL.

AFTER trying numerous ways of utilising the A.C. mains for wireless purposes, I finally decided on the small, home-made rotary converter which is described below.

This machine has given every satisfaction in charging the accumulators which I use on my wireless set, consisting of the usual filament lighting batteries, and also a Hart 50-volt accumulator, which I installed some time ago in place of dry batteries. It consists principally of an "Alterna" cycle generator, which is a six-pole machine and has a wound stator with a revolving field magnet.

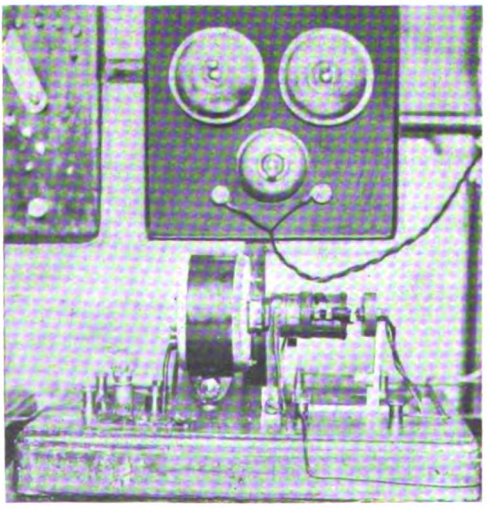

*Fig.* 1.

I found that this machine worked very well as a synchronous motor when its stator windings were supplied with A.C. at about 5 volts, the speed being 1,000 R.P.M. at 50 v. after being started by some external means.

The converting gear consists of two slip-rings and a twelve-part commutator, mounted on the projecting shaft. Alternate segments of the latter are simply used as spacers to prevent short-circuiting, leaving six "live" segments, three of which are connected to one slip-ring and three to the other, alternately, a brush rocker being provided so as to obtain maximum rectified current.

I have adapted an old core type 200/50 v. lighting transformer for use with this machine, and by means of the switchboard, seen in the top left-hand corner of the photograph (Fig. 1), any voltage in 5-volt steps can be obtained.

The whole arrangement will probably be better understood after a careful study of the diagram of connections (Fig. 2).

It will be seen that provision is made for electrical starting from the commutator side. With 6 or 8 volts the machine will run as a D.C. motor when

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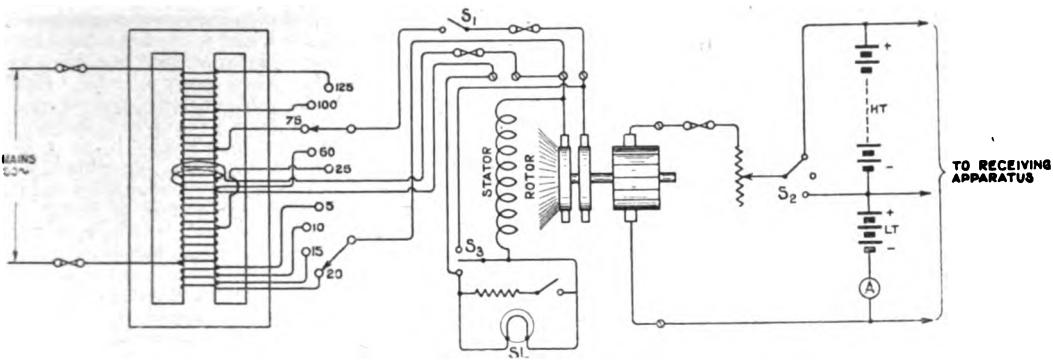


*Fig.* 2.

the stator winding is connected temporarily across the slip-rings by switch S 3, the speed being controlled by a variable resistance, R. When the correct speed is reached, the synchronising lamp, S.L., only just glows, and S 3 is put into the down position. The machine then runs as a synchronous motor, and after the correct A.C. voltage is obtained, say 10 per cent. above accumulator voltage, S 1 is closed and the charging current adjusted by variable resistance. A "charge" and "discharge" ammeter is used so as to be sure that the current is in the right direction. It is found, however, that the polarity is always correct when the machine is started up in the manner indicated.

This rotary converter will safely give 100 watts D.C. and any voltage with proportionately less current, if reasonably good insulation is provided, and the efficiency is remarkably good for so small a machine, the only appreciable loss being the power required to drive it—about 10 watts.

In conclusion, a study of the wave-form of the rectified current illustrated in Fig. 3, may be of interest.

It will be seen that a series of peaks is obtained and that when the A.C. instantaneous voltage falls below the accumulator voltage the circuit is automatically opened by the spacing segments on the commutator. Consequently, no reverse current can flow from the batteries and the charging current is due to the difference between the average rectified voltage and the accumulator voltage.

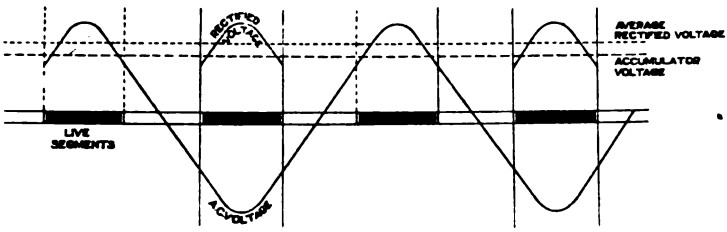


*Fig.* 3.

# The Future of the Wireless Telephone

ONE has only to pick up an American newspaper in order to appreciate how fully the wireless telephone has entered into the every-day life of Americans, who have been quick to appreciate its value, not only as a source of entertainment in the transmission of musical selections for the benefit of every home equipped with a wireless receiver, but also a tool in the purpose of education and the distribution of general information. Just as the cinematograph, which was at first launched solely as an entertainment, is now being used more and more in the purpose of education, so the wireless telephone can be employed for purposes of much greater value to the community than the mere transmission of concerts to individual homes.

Undoubtedly there is a fast-growing interest in wireless in this country and no stronger indication could be given than the very considerable attention which has been devoted recently to the subject by the daily press. This public interest has been largely stimulated by the action of the Wireless Society of London in obtaining recently the official sanction for the transmission of a weekly programme of telephony and calibration waves specially intended for the benefit of the amateur. These weekly transmissions, conducted by the Marconi Scientific Instrument Company, Ltd., are now listened to by an appreciative and ever-increasing audience, but it is not likely that the progress of the wireless telephone will stop here, and we may look forward to the time, when the wireless telephone will take its place amongst domestic equipments.

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In this connection, the opinions expressed by Mr. Godfrey Isaacs, Managing Director of Marconi's Wireless Telegraph Company, Ltd., are of extreme interest.

Mr. Godfrey Isaacs looks forward to the time when there will be a wireless receiving apparatus in every home and he outlines a programme for an organised public service which the Marconi Company is ready to put into operation as soon as the necessary authority has been obtained. In a statement made to the Press, Mr. Godfrey Isaacs said :

"You will probably have seen what has been taking place in the United States. There the thing has become a very great trade, and has developed very quickly. In my opinion, wireless telephony is destined to play a big part in the future in every country. Personally, I think that we shall be dependent on it in many ways, especially in the matter of general home propaganda, such as important speeches or proclamations, or anything of great importance which has to reach all parts of the country promptly. In addition, much will be done in the way of education, music, and, no doubt, by the transmission of weather news to farmers.

"My hope is that, in time, every home will have a wireless set. Our programme is more particularly to supply the instruments to the householder on hire. Our idea is to have 'broad-casting' stations, say, two or three, in different parts of the country, and to have a programme for different hours of the day. We shall transmit by particular wavelengths —if we get assistance, as I have no doubt we shall, from the authorities—which will be so confined as to reach only those who hire these particular receivers, so that nobody else will be disturbed, and the telephonic receivers will not be disturbed either by wireless telegraphic or telephonic communication.

"This, I think, will be the first start of the organisation, and subsequently, not only will there be a home service, but it will be possible to subscribe for a Continental service as well, from any part of the world, which one desires. I do not mean, of course, that that will happen to-morrow or the next day, but that I foresee as the ultimate development of what is now known as 'broad-casting.' I can quite well imagine that it will be possible before long for a man to have an apparatus fixed in a motor-car or train and to receive information while he is travelling."

Referring to the United States, Mr. Isaacs said that wireless telephony there had gone ahead very quickly—too quickly, he thought. He should not aim at doing the thing in this country in quite the same way as it is done there. He should want to see the problem more seriously handled here ; in America it was becoming somewhat of a craze. They were only waiting for the necessary facilities, and he thought that the Government intended to give them. In America there was no Government control at all ; in this country, of course, there was. While there were certain advantages in America from the lack of control, he thought that here we should eventually derive benefit if a certain amount of reasonable Government control was exercised, so as to prevent what might otherwise become a nuisance.

As to the question of cost, Mr. Isaacs said that he calculated the system could be carried out very economically. The receiving apparatus, which would be all that the householder would require, would be leased at quite a modest amount per annum. In America the apparatus was being sold, but he thought that was a great mistake. Modifications would be introduced from time to time in the apparatus, and once a man had bought his property he would not feel happy if, soon after, he had to buy something better. Of course, if the public wanted to buy the apparatus they could do so, but he recommended a system of hiring.

"I do not think," added Mr. Isaacs, "that anybody realises how big a thing this is going to be. A message sent out by the Government or the police could be in every home in the country in a second. We have been perfecting this system for a long time. At present, owing to regulations, we have been only able to give wireless concerts for about a quarter of an hour each week, but I anticipate that very shortly matters with regard to regulations will be more or less settled, and then we shall be prepared to go forward. We have been working in close touch and co-operation with the big American, German and French firms."

In an interview granted *The Wireless World and Radio Review*, Mr. Isaacs emphasised that everything was ready, so far as the Marconi Company was concerned, for going ahead with the supply to the public of wireless telephones in the home and that the moment the necessary authority could be obtained the project would be put into operation. The type of set which would be supplied would vary according to the distances over which reception would be required, a guarantee of good reception with the apparatus would be a strong point. Asked whether such a service to the public might not lead to competition with the daily newspapers, it was pointed out that the services of the daily press would not be interfered with in any way.

# Notes

## The Genoa Bulletins.

Press Bulletins relating to the Genoa Conference are being transmitted from the station **IDO**, S. Paolo, Rome, daily on 1,850 metres C.W. The periods of transmission are 1500 G.M.T. for 30 minutes, and 2300 G.M.T. for 2 hours.

## The Berne Service.

On the occasion of the opening of the new high speed wireless service between Berne (Switzerland) and Ongar (Essex) on April 12th a number of messages of appreciation of the new service were exchanged between prominent persons in this country and in Switzerland. The service opened with a message to the King from the President of the Swiss Federation, in the following terms :—

His Majesty, King George V, Windsor.

I am sure that I shall comply with the sentiments of the Swiss people in renewing to Your Majesty by this first message transmitted by the radio telegraphique service linking up our two countries the sentiments of traditional and constant friendship of Switzerland for Great Britain, and in expressing the wish that the

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ties which unite them already may develop each day.

HAAB, President of the Federation.

In the note regarding the Berne-Ongar Service, which was published in the issue of *The Wireless World and Radio Review* for April 22nd, the call of the Berne Station was incorrectly given as HBD, this should have been given as **HBB.**

**Programme of the 2MT Transmissions.**

We are informed that on Tuesday, May 2nd, in the transmission of telephony from **2MT**, it is hoped to include solos by the famous Scandinavian tenor, **Mr.** Laurencz Melchior, and on that occasion also, an address will be given by Mr. Stanley Lupino, of the Gaiety Theatre.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

*Re Harmonics.*

SIR,—I would like to confirm the opinion of your correspondent, Gordon Barnes, that Mr. Clinker's explanation of the phenomenon noticed by "Experimenter" is correct. It is really a contradiction in terms to speak of a "lower" harmonic, implying one whose period is greater than the fundamental, the prefixes "higher" and "lower" being redundant unless used in a relative sense.

Fourier's principle states that any physical quantity which is periodic in time, *i.e.*, which repeats its variations exactly in periods is resolvable into a series of sine components (usually of decreasing amplitude) of fundamental, and a number of harmonic frequencies which are (and this is the point of Fourier's principle) exactly multiple frequencies of the fundamental. The lowest component in the series is necessarily the fundamental.

In any kind of oscillation, it is necessary to distinguish between the ordinary harmonics which are really nothing else than irregularities in the fundamental (*e.g.*, those caused by working beyond the straight portion of a valve characteristic curve, or those existing in an alternator voltage wave, which may be called "forced" harmonics), and other free modes of oscillation. A system can have other modes of oscillation which are not exactly multiple frequencies of the fundamental, though in simple cases, *e.g.*, that of the stretched wire, referred to by your correspondent, the free modes of oscillation are exact multiples. If, however, the string were weighed at any point, it would then have other free modes of oscillation which were not multiples of the fundamental, whilst at the same time the fundamental could have irregularities which were.

An electrical example which will occur to your readers is that of a receiving coil shunted by a condenser in which, owing to distributed capacity effects, oscillations can occur at higher frequencies, not exactly multiple, of the fundamental. Thus the total effect would not necessarily be strictly periodic.

It would appear that the oscillation generated by an arc or valve transmitter is perfectly periodic because we do not seem to be able to tune in on any other wavelengths than the exact sub-multiples, though there appears no reason why other free modes of oscillation should not be excited (the arc or valve being only an agent, not determining the frequencies like an alternator), each of which has its own fundamental, with *its* irregularities, *i.e.*, harmonics.

On my own set, at present of the single valve auto heterodyne arrangement, ranging from 300 to 35,000 metres, I can frequently hear stations well above Bordeaux, Carnarvon particularly, on 28,000 metres, and I have never considered this otherwise than that it is a forced oscillation of Carnarvon frequency beating with the second harmonic of my own oscillation. One of the tests for this has already been described in your columns, viz., that the maximum strength of such a signal appears with a relatively larger amount of reaction than in the case of a fundamental or ordinary harmonic, but there is another, namely, that the rate at which the beat note rises on either side of the dead point in such a reception is twice (or more as the case may be) as great as for the ordinary fundamental.

Further remarks from Mr. Clinker would be interesting.

E. FOWLER CLARK.

Derby.
*April 7th*, 1922.

## NOTES ON A DIRECT-READING RADIO DIRECTION FINDER.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—As THE RADIO REVIEW ceases publication and is incorporated with your journal, I beg you to allow publication of this letter, answering Mr. Artom's letter published in the last number of THE RADIO REVIEW under the above title.

Mr. Artom's letter, besides its discourteous and peremptory tone, contains several inexactitudes:

1.—It is incorrect that the County Court and the Cassation Courts of Turin have established Mr. Artom's priority to the invention of the magnetic radiogoniometer. The County Court Judgment (July 18th, 1914) neatly declares: "IT IS NOT DECIDED HERE WHETHER THE INVENTIONS MAKING THE OBJECT OF THE ITALIAN PATENTS NO. 88,765 AND 88,766 WERE MADE BY THE SCIENTISTS BROWN AND BLONDEL OR BY MR. ARTOM OR BY MESSRS. BELLINI AND TOSI . . . . . ." The Cassation Courts (June 8th, 1915) did not affirm anything, as their duty was simply dealing with formal matters. The public act of April 5th, 1912, does not deal at all with radiogoniometers. I hold these three documents at the disposal of any who may be interested to see them.

What is most striking is the fact that at the discussion I and my partners asked the Courts to decide who was the inventor of the magnetic radiogoniometer and that it was Mr. Artom who was opposed to the Courts taking this point into consideration. The object of the litigation was the Artom directive system employing circularly or elliptically polarised waves.

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In this connection, the opinions expressed by Mr. Godfrey Isaacs, Managing Director of Marconi's Wireless Telegraph Company, Ltd., are of extreme interest.

Mr. Godfrey Isaacs looks forward to the time when there will be a wireless receiving apparatus in every home and he outlines a programme for an organised public service which the Marconi Company is ready to put into operation as soon as the necessary authority has been obtained. In a statement made to the Press, Mr. Godfrey Isaacs said :

"You will probably have seen what has been taking place in the United States. There the thing has become a very great trade, and has developed very quickly. In my opinion, wireless telephony is destined to play a big part in the future in every country. Personally, I think that we shall be dependent on it in many ways, especially in the matter of general home propaganda, such as important speeches or proclamations, or anything of great importance which has to reach all parts of the country promptly. In addition, much will be done in the way of education, music, and, no doubt, by the transmission of weather news to farmers.

"My hope is that, in time, every home will have a wireless set. Our programme is more particularly to supply the instruments to the householder on hire. Our idea is to have 'broad-casting' stations, say, two or three, in different parts of the country, and to have a programme for different hours of the day. We shall transmit by particular wavelengths —if we get assistance, as I have no doubt we shall, from the authorities—which will be so confined as to reach only those who hire these particular receivers, so that nobody else will be disturbed, and the telephonic receivers will not be disturbed either by wireless telegraphic or telephonic communication.

"This, I think, will be the first start of the organisation, and subsequently, not only will there be a home service, but it will be possible to subscribe for a Continental service as well, from any part of the world, which one desires. I do not mean, of course, that that will happen to-morrow or the next day, but that I foresee as the ultimate development of what is now known as 'broad-casting.' I can quite well imagine that it will be possible before long for a man to have an apparatus fixed in a motor-car or train and to receive information while he is travelling."

Referring to the United States, Mr. Isaacs said that wireless telephony there had gone ahead very quickly—too quickly, he thought. He should not aim at doing the thing in this country in quite the same way as it is done there. He should want to see the problem more seriously handled here ; in America it was becoming somewhat of a craze. They were only waiting for the necessary facilities, and he thought that the Government intended to give them. In America there was no Government control at all ; in this country, of course, there was. While there were certain advantages in America from the lack of control, he thought that here we should eventually derive benefit if a certain amount of reasonable Government control was exercised, so as to prevent what might otherwise become a nuisance.

As to the question of cost, Mr. Isaacs said that he calculated the system could be carried out very economically. The receiving apparatus, which would be all that the householder would require, would be leased at quite a modest amount per annum. In America the apparatus was being sold, but he thought that was a great mistake. Modifications would be introduced from time to time in the apparatus, and once a man had bought his property he would not feel happy if, soon after, he had to buy something better. Of course, if the public wanted to buy the apparatus they could do so, but he recommended a system of hiring.

"I do not think," added Mr. Isaacs, "that anybody realises how big a thing this is going to be. A message sent out by the Government or the police could be in every home in the country in a second. We have been perfecting this system for a long time. At present, owing to regulations, we have been only able to give wireless concerts for about a quarter of an hour each week, but I anticipate that very shortly matters with regard to regulations will be more or less settled, and then we shall be prepared to go forward. We have been working in close touch and co-operation with the big American, German and French firms."

In an interview granted *The Wireless World and Radio Review*, Mr. Isaacs emphasised that everything was ready, so far as the Marconi Company was concerned, for going ahead with the supply to the public of wireless telephones in the home and that the moment the necessary authority could be obtained the project would be put into operation. The type of set which would be supplied would vary according to the distances over which reception would be required, a guarantee of good reception with the apparatus would be a strong point. Asked whether such a service to the public might not lead to competition with the daily newspapers, it was pointed out that the services of the daily press would not be interfered with in any way.

# Notes

## The Genoa Bulletins.

Press Bulletins relating to the Genoa Conference are being transmitted from the station **IDO**, S. Paolo, Rome, daily on 1,850 metres C.W. The periods of transmission are 1500 G.M.T. for 30 minutes, and 2300 G.M.T. for 2 hours.

## The Berne Service.

On the occasion of the opening of the new high speed wireless service between Berne (Switzerland) and Ongar (Essex) on April 12th a number of messages of appreciation of the new service were exchanged between prominent persons in this country and in Switzerland. The service opened with a message to the King from the President of the Swiss Federation, in the following terms :—

His Majesty, King George V, Windsor.

I am sure that I shall comply with the sentiments of the Swiss people in renewing to Your Majesty by this first message transmitted by the radio telegraphique service linking up our two countries the sentiments of traditional and constant friendship of Switzerland for Great Britain, and in expressing the wish that the

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ties which unite them already may develop each day.

HAAB, President of the Federation.

In the note regarding the Berne-Ongar Service, which was published in the issue of *The Wireless World and Radio Review* for April 22nd, the call of the Berne Station was incorrectly given as HBD, this should have been given as HBB.

**Programme of the 2MT Transmissions.**

We are informed that on Tuesday, May 2nd, in the transmission of telephony from 2MT, it is hoped to include solos by the famous Scandinavian tenor, Mr. Laurencz Melchior, and on that occasion also, an address will be given by Mr. Stanley Lupino, of the Gaiety Theatre.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

*Re Harmonics.*

SIR,—I would like to confirm the opinion of your correspondent, Gordon Barnes, that Mr. Clinker's explanation of the phenomenon noticed by "Experimenter" is correct. It is really a contradiction in terms to speak of a "lower" harmonic, implying one whose period is greater than the fundamental, the prefixes "higher" and "lower" being redundant unless used in a relative sense.

Fourier's principle states that any physical quantity which is periodic in time, *i.e.*, which repeats its variations exactly in periods is resolvable into a series of sine components (usually of decreasing amplitude) of fundamental, and a number of harmonic frequencies which are (and this is the point of Fourier's principle) exactly multiple frequencies of the fundamental. The lowest component in the series is necessarily the fundamental.

In any kind of oscillation, it is necessary to distinguish between the ordinary harmonics which are really nothing else than irregularities in the fundamental (*e.g.*, those caused by working beyond the straight portion of a valve characteristic curve, or those existing in an alternator voltage wave, which may be called "forced" harmonics), and other free modes of oscillation. A system can have other modes of oscillation which are not exactly multiple frequencies of the fundamental, though in simple cases, *e.g.*, that of the stretched wire, referred to by your correspondent, the free modes of oscillation are exact multiples. If, however, the string were weighed at any point, it would then have other free modes of oscillation which were not multiples of the fundamental, whilst at the same time the fundamental could have irregularities which were.

An electrical example which will occur to your readers is that of a receiving coil shunted by a condenser in which, owing to distributed capacity effects, oscillations can occur at higher frequencies, not exactly multiple, of the fundamental. Thus the total effect would not necessarily be strictly periodic.

It would appear that the oscillation generated by an arc or valve transmitter is perfectly periodic because we do not seem to be able to tune in on any other wavelengths than the exact sub-multiples, though there appears no reason why other free modes of oscillation should not be excited (the arc or valve being only an agent, not determining the frequencies like an alternator), each of which has its own fundamental, with *its* irregularities, *i.e.*, harmonics.

On my own set, at present of the single valve auto heterodyne arrangement, ranging from 300 to 35,000 metres, I can frequently hear stations well above Bordeaux, Carnarvon particularly, on 28,000 metres, and I have never considered this otherwise than that it is a forced oscillation of Carnarvon frequency beating with the second harmonic of my own oscillation. One of the tests for this has already been described in your columns, viz., that the maximum strength of such a signal appears with a relatively larger amount of reaction than in the case of a fundamental or ordinary harmonic, but there is another, namely, that the rate at which the beat note rises on either side of the dead point in such a reception is twice (or more as the case may be) as great as for the ordinary fundamental.

Further remarks from Mr. Clinker would be interesting.

E. FOWLER CLARK.

Derby.
*April 7th*, 1922.

## NOTES ON A DIRECT-READING RADIO DIRECTION FINDER.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—As THE RADIO REVIEW ceases publication and is incorporated with your journal, I beg you to allow publication of this letter, answering Mr. Artom's letter published in the last number of THE RADIO REVIEW under the above title.

Mr. Artom's letter, besides its discourteous and peremptory tone, contains several inexactitudes:

1.—It is incorrect that the County Court and the Cassation Courts of Turin have established Mr. Artom's priority to the invention of the magnetic radiogoniometer. The County Court Judgment (July 18th, 1914) neatly declares: "IT IS NOT DECIDED HERE WHETHER THE INVENTIONS MAKING THE OBJECT OF THE ITALIAN PATENTS No. 88,765 AND 88,766 WERE MADE BY THE SCIENTISTS BROWN AND BLONDEL OR BY MR. ARTOM OR BY MESSRS. BELLINI AND TOSI . . . . . ." The Cassation Courts (June 8th, 1915) did not affirm anything, as their duty was simply dealing with formal matters. The public act of April 5th, 1912, does not deal at all with radiogoniometers. I hold these three documents at the disposal of any who may be interested to see them.

What is most striking is the fact that at the discussion I and my partners asked the Courts to decide who was the inventor of the magnetic radiogoniometer and that it was Mr. Artom who was opposed to the Courts taking this point into consideration. The object of the litigation was the Artom directive system employing circularly or elliptically polarised waves.

2.—The Italian, French and German Patents cannot be referred to for claiming priority, as these Patents can be obtained in anyone's name, be he the inventor or not. Only the British, Canadian, Indian, U.S., Australian, etc., Patents can be referred to for this purpose as to obtain these

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Patents it is necessary to declare or to swear to be the sole and real inventor. All these Patents for the magnetic radiogoniometer are in the names Bellini and Tosi.

The Patents for the electrostatic radiogoniometer are also all in my name.

3.—It would be too long and tedious to explain how Mr. Artom was able to obtain the Italian, French and German Patents in his name. What is interesting to know is that I had communicated my invention to Mr. Artom with my letters to him dated February 27th and March 1st, 1907, and that Mr. Artom answered me on March 4th acknowledging receipt of my letters and of my invention. The translation of the part of this letter concerning the invention of the magnetic radiogoniometer is as follows:—

"I THANK YOU FOR YOUR LETTERS OF FEBRUARY 27TH AND MARCH 1ST. I VERY MUCH APPROVE THE APPARATUS PROPOSED AND IMAGINED BY YOU FOR THE DETERMINATION OF THE AZIMUTH AND I HOPE THAT YOU WILL ALSO SUCCEED IN OVERCOMING THE DIFFICULTIES OF CONSTRUCTION WITH WHICH YOU WILL MEET. ALTOGETHER IT WOULD BE CONVENIENT TO COVER THE THING IMMEDIATELY BY A PATENT."

The photographic reproduction of this letter appeared in the *Electrician* advertisement pages for January 2nd and February 13th, 1920.

4.—Mr. Artom does not answer my technical observations upon the direct-reading radiogoniometer set forth by him. I am, therefore, justified in admitting that he finds my observations right, in spite of his contrary declarations.

E. BELLINI.

Enghien-les-Bains,
*April 10th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—This is to tell you I have just received very good signals from station **2 CV.** I heard him several times from 2103 till 2126 G.M.T., when I closed down.

His signals were pure C.W. on about 400 metres and were quite strong and remarkably steady; I could read them easily through heavy QRN. He was working with station **2 DM.**

Being unable to find this station on the lists I have I would very much appreciate your letting **2 CV** know of his reception here and that I am at his entire disposal for more details.

Yours sincerely,
LÉON DELOY.
"French 8 AB."

Radio-Club de la Côte D'Azur,
Nice.
*Sunday, April 16th*, 1922. (2200 G.M.T.).

**8 AB.**—(M. Léon Deloy, Villa des Hautes-Roches, 55, Boulevard Mont-Boron, Nice) transmits almost daily on 525 metres C.W. from 2100 to 2115 and listens in on 200 metres between 2045 and 2230 B.S.T.

# Calendar of Current Events

**Saturday, April 29th.**

LUTON WIRELESS SOCIETY.
Public Exhibition.

SUNDERLAND WIRELESS AND SCIENTIFIC SOCIETY.
At the Technical College, "Telephony," by Mr. T. Brown Thomson.

**Tuesday, May 2nd.**

TRANSMISSION OF TELEPHONY at 7 *to* 7.25 *p.m.* on 700 metres, followed by C.W. Calibration Signals on 1,000 metres, by **2MT** from Writtle, near Chelmsford.

**Wednesday, May 3rd.**

COWES AND DISTRICT RADIO SOCIETY.
"The Application of Three-Electrode Valves to Transmitting."

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION).
6 *p.m.*—"Prevention of Interference in Wireless Telegraphy" (Provisional), by Mr. C. S. Franklin.

**Thursday, May 4th.**

KENSINGTON WIRELESS SOCIETY.
8.30 *p.m.*—At 2, Penywern Road.
"The Inner Mysteries of Thermionic Valve Manufacture," by Mr. J. F. Turner (Wandsworth Wireless Society).

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
"Lantern Lecture and Demonstration," by Mr. Oswald Carpenter, Associate I.R.E.

**Friday, May 5th.**

WIRELESS SOCIETY OF HIGHGATE.
"Production of Low-Frequency Oscillations by the Valve," by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS' SECTION).
7 *p.m.*—"Electrically Oscillatory Discharges," by Mr. R. P. Howgrave-Graham.

**Thursday, May 11th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.
Demonstration of Recording, by Mr. W. A. Brooke.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
"Transformer Coupled H.F. Amplification," by Mr. Edward Mc.T. Reece.

**Friday, May 12th.**

PHYSICAL SOCIETY.
5 *p.m.*—At the Imperial College of Science, South Kensington. "Experiments with Neon Gas Filled Lamps," demonstration, by Mr. S. O. Pearson, B.Sc., and Mr. H. Anson.

WIRELESS SOCIETY OF HIGHGATE.
"The Action of the Valve in the Light of the Electron Theory," by Mr. D. H. Eade.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
"The Principles of Tuning," by Mr. H. F. Yardley.

**Saturday, May 13th.**

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).
*Afternoon.*—Visit to Victoria Telephone Exchange.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford.

A meeting was held in the Club Room at 7.45 p.m. on April 7th, Mr. W. C. Ramshaw in the chair. Following the business of the meeting, three new members were elected.

The Chairman, then called upon Mr. N. Whiteley to give his address on "Mesopotamia." The lecturer commenced with a brief geographical survey of the country and followed this up with an outline of the British campaigns there, ending with his own personal wireless experiences in that country and India. The lecture was admirably illustrated by lantern slides made from the lecturer's own photographs and was very much enjoyed by those present. A hearty vote of thanks was carried unanimously.

Will all interested in the Society please note that during the temporary absence of the Hon. Secretary, all communications should be addressed to the Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds, when they will receive prompt attention.

### Dartford and District Wireless Society.*

Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Dartford.

The members of the above Society held their usual fortnightly meeting on Friday, April 7th, 1922. Mr. J. R. Smith, A.M.I.E.E., Vice-President, in the chair. Opportunity was taken on this occasion to thoroughly test the aerial since the desired alterations had been carried out and it was very gratifying to note a considerable improvement.

The Society's crystal receiving set had been overhauled and reconditioned by Mr. Lyne and is now satisfactory, giving good signals. A 3-valve set with reaction was brought for demonstration by Mr. O'Keeffe, also a single valve amplification set, using a 5 electrode valve, by Mr. Prangnell, the Assistant Secretary. This valve amplifies approximately six times and is provisionally patented by Mr. Prangnell. Extremely good signals were received, the results on these home-constructed instruments being very satisfactory.

Mr. Prangnell also gave descriptive circuits for transmission and reception, using his special valve.

### Kensington Wireless Society.*

A meeting was held at 2, Penywern Road on Thursday, April 6th. After the business of the evening had been disposed of, Mr. F. H. Haynes presented a paper on "Methods of Amplification and the Construction of Amplifying Apparatus."

He described all the modern methods of obtaining amplification and the merits of each, giving constructional details of the transformers, resistances, condensers, etc., used in each case.

The meeting was temporarily adjourned at 9.15 p.m. to "listen in" to the concert which was being transmitted to the Aeolian Hall, and to examine a Johnson-Rahbeck Agate Loud Speaker Amplifier made by Mr. Haynes, the instrument being capable of giving tremendous amplification without distortion.

On resuming, the lecturer concluded by giving details of some novel types of amplifier with which he is experimenting.

Some discussion ensued, after which Mr. Haynes was very heartily thanked, and the meeting was adjourned.

Next meeting, Thursday, May 4th.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, South Kensington.

### Leamington Spa and Warwick.

Mr. Frank A. Sleath, of 31, Archery Road, Leamington Spa, and late Secretary to the Gravesend Wireless Society, is desirous of forming a Wireless Society in the Leamington and Warwick district.

Will all those who are interested communicate with him, or call between 2.30 and 4 p.m. on Sundays.

Judging by the interference on "Concert" nights there must be several amateurs in the immediate vicinity who are either experiencing great difficulty in getting **2 MT**, or they are getting the music with a beautiful "howl" accompaniment.

### The Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting was held on Friday, April 14th, at the Leeds University, Mr. G. P. Kendall, B.Sc. (Vice-President), taking the chair at 8.30 p.m. The Chairman called upon Capt. F. A. Whitaker, R.E. (Vice-President), to deliver a paper on the subject of "High Frequency Amplification."

As the subject has been receiving much attention lately, the lecture was particularly enjoyable and in keeping with the times. Capt. Whitaker commenced with a brief explanation of the terms rectification, high frequency amplification, and low frequency magnification, and with the aid of rough blackboard characteristic curves showed just how it was possible to work the valve accordingly. He proceeded to show why H.F. amplification is to be preferred for general reception. H.F. amplification is by no means as straightforward a procedure as L.F. magnification, but in the long run it pays to put in the valves on the H.F. side of the rectifier. Moreover, it is practically essential to use H.F. amplification to get really strong and clear speech or music when receiving telephony.

Various methods of coupling triodes together when operating at radio frequency were next considered; the lecturer touching on the practical side of business frequently. These modes of coupling included many types of inductively coupled circuits, such as the ordinary copper wire aperiodic tightly

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coupled air core transformer; ditto, with condensers in shunt across the primary and/or secondary for "tuned" transformers; resistance wound aperiodic and periodic transformers, etc. Capt. Whitaker did not definitely state that these various H.F. transformers did transform electromagnetically or whether it was an electrostatical effect; but one thing is certain, and that is by not committing himself, Capt. Whitaker undoubtedly saved the meeting from a heated discussion later on. He also explained certain methods of direct coupling, wherein it is usual to rectify at the next valve with the aid of a grid condenser, which in addition successfully insulates the grid of that valve from the positive H.T. supplying the H.F. valve. Resistance capacity and reactance capacity couplings were next considered and explained in detail. Nevertheless the lecturer, unknowingly, completely ionized some of those present (including the Hon. Secretary) with regard to the latter type of coupling. He referred the meeting to the current issue of *The Wireless World and Radio Review* for further information on this particular system of coupling. Radio frequency amplifiers using iron core transformers were touched upon, as were certain types of H.F. sets using condensers only. Capt. Whitaker had on view numerous types of H.F. transformers, including one of the iron core type.

A lively discussion was then opened, and Capt. Whitaker was kept very busy for some time. The subject offered so large a field for argument that the discussion could have proceeded almost indefinitely, but eventually the meeting came to the conclusion that, as Capt. Whitaker said in the course of his lecture, "some very funny things happen with H.F. amplifiers," and so the meeting was closed after a hearty vote of thanks had been accorded to Capt. Whitaker at 10.40 p.m.

**Sheffield and District Wireless Society.***

Hon. Secretary, Mr. L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

On the 7th inst., at the Department of Applied Science, George Square, Sheffield, Mr. F. Gilberthorpe gave an interesting paper on "Syntony and Resonance" as applied to radio communication by slides, diagrams and formula.

The importance of resonance in its application to physical phenomena was clearly demonstrated, also the accidental production of resonance in low frequency circuits and the effect of resistance and damping.

A full discussion followed, after which the lecturer was given a very hearty vote of thanks.

The Society has now received a transmitting licence for permission to communicate with the Manchester Wireless Society between certain defined hours, which will be advised later.

**Sussex Wireless Research Society.***

Hon. Secretary, Mr. Edward Hughes, B.Sc., A.M.I.E.E., The Technical College, Brighton.

At a meeting of the above Society held at Cottesmore School, Upper Drive, Hove, the President, Capt. Hoghton, M.Inst.P., gave a lecture dealing with "Recent Developments in Valves." The action of the 4-electrode valve was explained and the applications of these valves to transmission and reception circuits was dealt with. Capt. Hoghton also explained at length the principle underlying the action of the dynatron, and emphasised the advantages and immense possibilities of a valve possessing "negative" resistance. The lecturer finally dealt briefly with the developments that are taking place in regard to filament construction and the mechanical design of valves.

**The West London Wireless and Experimental Association.***

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

At the meeting held on Thursday, April 6th, buzzer practice was given by Mr. Winnett and many members availed themselves of the opportunity to brighten up their Morse.

Following this the Association's apparatus was tuned up and the concert specially transmitted by the Marconi Scientific Instrument Co. to the Aeolian Hall at 9.15 p.m. was successfully picked up and with the aid of the loud speaker all present were able to hear the music sent out. After this the President announced that the Committee hoped to fix up a half-day outing during June and the Secretary was going to get in touch with the authorities with a view to paying a visit to the Croydon Radio Station and Aerodrome. However, more of this anon.

Members are specially requested to make a note of the forthcoming lectures (*see Calendar of Current Events*).

The Secretary will have much pleasure in replying to applications regarding objects of the Association and on qualifications for membership.

Another successful meeting was held Thursday evening, April 13th. Morse practice was again kindly given by Mr. H. P. Winnett; afterwards "listening in" with the aid of the loud speaker resulted in the reception of music and telephony. A paper was then read by Mr. Winnett entitled "Land Telegraphy." The simplex and duplex systems were minutely described and explained with the assistance of diagrams. Questions were invited and the speaker fully replied to those who had questioned him.

The Vice-President, Mr. F. E. Studt, took the opportunity to present a short wave tuner, of his own construction, together with a chart of curves to the Association, and a very hearty vote of thanks was accorded him for this very useful gift. With this latest addition to our apparatus it will now be possible to receive signals and radio telephony on very short wavelengths.

The Secretary desires all members to bear in mind the previously announced demonstrations.

It is hoped to shortly announce definite date for half-day outing and members are asked to carefully watch the "Calendar of Current Events" for all future information.

The Secretary will have much pleasure in answering any enquiries respecting objects of the Association and qualifications for membership.

**The Wireless and Experimental Association.***

At the Central Hall, Peckham, on April 12th, the Association had the pleasure of listening to a lecture on transmitting by their old member, Lieut. Owen.

Few of our members have transmitting licences, but, like the boy who cut his drum open, we dreadfully want to know where the sound comes from and it adds greatly to our interest in receiving signals if we know perfectly well how they are sent out. A trial has been arranged for comparison of a 500 cycle transmission and a 50 cycle transmission and many of the ears will be strained to detect the

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difference, if any. Many were the useful hints and data given as to winding transformers for transmission, and no longer should our wireless neighbours 20 miles away make cursory remarks about the broadness of front of our spark transmission wave.

Hon. Secretary, Mr. George Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

### The North Essex Wireless Society.

Headquarters, 15, Rayne Road, Braintree.

On April 4th the members of the North Essex Wireless Society arranged a free public lecture and demonstration of Wireless reception at the Y.M.C.A. Hall, Braintree. The President of the Society (Mr. H. E. Adshead, B.A.) gave the lecture and the apparatus was demonstrated by Messrs. Gordon Castagnoli and F. T. Smith. The former gentleman kindly lent all the apparatus, including home-made loud speakers. The Hall was well filled and the audience were able to hear the well-known Marconi concert from **2 MT** and applauded each item to show their appreciation.

The apparatus used consisted of two H.F. transformer coupled valves, one detector and four L.F. valves, making in all a very efficient seven-valve receiver.

The Secretary made formal announcements on the work of the Society and suggested that the occasion should bring several new members.

Thanks were accorded to the lecturer and demonstrators in the usual hearty manner and several donations were received by the Secretary towards the Society's work.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

At the meeting of the above Society, held at its Headquarters, the Kingsland Assembly Rooms, on Wednesday last, April 12th, a most interesting and enjoyable evening was spent. After the usual buzzer practice, business of the Club was commenced. Minutes of the last meeting were read and approved.

The Secretary announced that a cheque had been received from Sir G. Cooper for the Club funds, also that General Sir I. Phillips, M.P., and W. Dudley Ward, Esq., M.P., had both accepted the Presidency of the Club, and had both kindly presented cheques, the one from Mr. Dudley Ward being a particularly substantial one, much needed.

It was also announced that Dr. J. T. M. McDougall and G. South, Esq., had accepted the Vice-Presidency of the Club and also promised to assist the Society in whatever they required. After all the correspondence was read Mr. Bateman was asked to continue his lecture on "Accumulator Charging," and the "Wheatstone Bridge." The lecture outlined most clearly the working of the Wheatstone Bridge. At the conclusion all questions put to the lecturer were answered to the satisfaction of the members. The meeting finally closed at 10 p.m.

The large numbers of members present indicate the keen interest which is being taken locally in Wireless Telegraphy, and also in the lectures.

### Stoke-on-Trent Wireless and Experimental Society.

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley, Stoke-on-Trent.

The Society held an exhibition and demonstration of wireless apparatus in the Town Hall, Burslem, from March 30th to April 1st.

The exhibition was attended by considerable success, this being in a great measure due to the hearty and loyal co-operation of the members. A considerable amount of apparatus (representative of all types) was placed on exhibition by the members and the room showed quite an imposing and pleasing appearance.

An attractive programme was arranged, three different types of apparatus being used in turn for demonstrations in reception. At intervals Messrs. A. H. Wilson and F. Jenkinson treated the visitors to a short but apparently much appreciated lecture on the subject of "New Wireless Works."

Arrangements were made for the showing, in an adjoining room, of two "Bray Pictorial" cinematograph films, the first illustrated the working of the ordinary telephone and the second conveyed in a very simple manner to the lay mind the principle underlying wireless telephony. This was followed by a description of and demonstrations with X-rays. At one time a considerable stir was caused amongst the visitors by the reception of telephony which was audible to all by means of an amplifier and loud speaker.

Our thanks are due to the Wireless Press for a good selection of books, which were much appreciated, and to the Hart Accumulator Co., for the loan of accumulators for show purposes.

Many expressions of appreciation have been received from members of the public, and all the Society's members feel that they have been amply repaid for the time and trouble expended by these alone. The Society's funds have been substantially benefited and an appreciable increase in the membership has resulted.

### Wolverhampton and District Wireless Society.

On the 5th April, at a General Meeting held at Headquarters, 26, King Street, Wolverhampton, the Vice-Chairman, Mr. Geo. W. Fairall, read a paper on "The Early History of Electricity." Commencing with the lodestone and its discovery he took his hearers through the years of progress to modern electric lighting and telegraphy, interspersing his remarks with anecdotes of the great men to whom we owe so much. Some of these were amusing, and his description of Edison rubbing two cats together to generate electricity showed a humorous side of science. A piece of the first Atlantic cable was handed round for inspection and Mr. Fairall's paper came to an end all too soon.

At the meeting held on the 12th April, Mr. A. E. Jones gave a lecture on Accumulators, pointing out the necessity of using the correct proportions of brimstone sulphuric acid and distilled water and the general care of accumulators if trouble was to be avoided and what to do when matters went wrong. His lecture will probably save some of the members' batteries "going west," and incidentally, their pocket money.

Hon. Secretary, Mr. Geo. W. Jones, 8, Roseberry Street, Wolverhampton.

### Border Wireless Club.

Mr. James W. Blake, The Square, Kelso, Scotland, will be pleased to hear from gentlemen in the Border Counties who are interested in wireless, and who are desirous of forming a Border Wireless Club.

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### Lincoln Wireless and Scientific Society.*

With a view to attracting new members a public exhibition of wireless apparatus was given by the Society in the Gymnasium at the Municipal Technical School, Lincoln, on April 11th and 12th, 1922. Most of the apparatus shown was home-made by members of the Society, and sets were exhibited by Messrs. Astill, Bates, Cottam, Elsey, Friskney, Harrison, Herring, Issott, Mawer and Townhill.

A set of "Tingey" units, the property of the Technical School, was also on view.

C.A.V. accumulators supplied the current for the various sets and the local agent had a stand of various electrical apparatus.

On Tuesday evening the concert given by **2 MT** was picked up on Mr. Harrison's home-made set, and by means of a loud speaker, the visitors, numbering about 300, were given a musical treat, which to many of them was a great surprise, and numerous comments were heard on the clearness of the speech. Later in the evening Mr. A. E. Collis, M.I.M.E., Whit.Ex., Head Master of the Technical School, expressed his appreciation of the trouble taken and the great amount of work done by the Chairman and members of the Wireless Society to give the public such splendid results of their study of wireless.

At intervals during both Tuesday and Wednesday evenings, Mr. C. Friskney (Chairman of the Society) explained to the visitors the various pieces of apparatus and invited questions from any who were interested in wireless.

Each evening part of a "CQ" message from Leafield was received and written on a blackboard by Mrs. Elsey (wife of the Secretary), much interest being created thereby.

Altogether the event was quite successful as an exhibition, and it is hoped that it may be the means of drawing the attention of those interested to the fact that there is a live wireless society in Lincoln, and that a number of new members may be the result.

Great credit is due to the Exhibition Sub-Committee, Messrs. Friskney, Harris and Issott, with Mr. F. Mawer as Secretary, for the splendid work done in organising such a successful show.

Hon. Secretary, Mr. H. E. Elsey, Rosebery Avenue, Lincoln.

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# An Echo of the Transatlantic Tests

IN the issue of *The Wireless World* for October 29th, 1921, in outlining the conditions of entry for the recently conducted Transatlantic Tests, we quoted a criticism of the capabilities of the British amateurs to receive the signals which had appeared in the American journal, *Q.S.T.* The quotation was as follows :—

"Such reception is a new field for British experimenters, and they hardly can be expected to show the same performance as an American dyed-in-the-wool ham who has learned how to get amateur DX only after years of patient struggle. We have tested most of the circuits used by the Britishers, and find them one and all decidedly inferior to our standard American regenerative circuit using variometer tuning in secondary and tertiary circuits. We would bet our new spring hat that if a good U.S. amateur with such a set and an Armstrong Super could be sent to England, reception of U.S. amateurs would straightway become commonplace.

"We do not mean to deprecate the loyal co-operation shown by our English confrères, however. For the admirably complete way in which they go into a problem we have the greatest respect, and we are most sincerely grateful for their interest and enthusiastic co-operation in this, our first attempt to get overseas on schedule. We will all hope for better luck next time."

The author of this criticism was Mr. Kenneth B. Warner, of the American Radio Relay League, and his bet of a "new spring hat" was taken up in this country by Mr. W. W. Burnham.

Success rewarded the efforts of the "good U.S. Amateur," and although the laurels were shared with the British amateurs, the bet of the "new spring hat" still stood. We give here an illustration of the hat prepared for Mr. Warner, which has just been dispatched to the States by Mr. Burnham.

The hat is of light grey felt and bears on one side the stars and stripes, and on the other the Union Jack united by wireless flashes encircling the crown. In front can be seen the inscription of dedication. Unfortunately, the photograph cannot

reproduce the colours of this work of art, so that a full appreciation of its beauty is not possible.

We wonder if Mr. Warner will make use of his new hat for official occasions, and we expect from him a photograph with the hat on.

We wonder also whether Mr. Burnham took his measurements before or after the success of the Tests!

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only.* (2) *Queries should be clear and concise.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *Four questions is the maximum which will be accepted at a time.*

**"F.E.S." (Ealing)** *asks* (1) *If it is possible to reproduce speech and music for a large room of as good quality as that of a modern gramophone.* (2) *For any literature on distortionless speech reproduction.*

(1) Speech and music can be reproduced to fill a large room but there is always a certain amount of distortion present. This is due partly to wireless troubles and partly to reproduction troubles, *e.g.*, with a loud speaker. The wireless troubles can be largely got over by using valves whose characteristic is very straight over part of their range, and by so arranging the circuit that operation occurs on the straight part. High-frequency amplification is recommended. The reproduction part of the trouble cannot be regarded as properly solved at present. As you suggest, the loud speaker is not very good and we advise you to adopt a loud speaker of the Rahbek and Johnston type, experimenting to find the most suitable practical arrangement. (2) We do not know of any recent publications on this matter which will meet your requirements.

**"C.A.N." (Bury St. Edmunds)** *asks* (1) *The advantages of a two circuit receiver over one with a single circuit.* (2) *If it is normal for his simple crystal set to give Croydon telephony and C.W. Stations.* (3) *If any stations send out between 5 and 7 p.m. such news as appears on tape machines.* (4) *Asks which of several valves to use for a detector.*

(1) A two circuit receiver gives better selectivity and also minimises re-radiation. (2) Reception of Croydon is normal; reception of C.W. signals, if with a clear note, is abnormal and probably due to interference by some oscillating circuit in the neighbourhood. If, however, you get these stations with a barely readable hiss the result is nothing unusual. (3) We do not know of any such stations. (4) Any of the valves you mention should be suitable.

**"A.E." (Cambridge)** *asks* (1) *For criticism of a crystal set.* (2) *If it would receive* **2 MT.** (3) *What time* **2 MT's** *concert takes place.* (3) *If an aerial would be satisfactory with telephone lines about 30 ft. away and a little higher than the aerial.*

(1) O.K. (2) Yes, if the coil is of the right size. (3) Tuesdays, 7 to 7.30 p.m. (3) Fairly well, but it will be desirable for the aerial not to be parallel to the telephone wires.

**"ANODE" (Wendover)** *asks* (1) *For criticism of a single valve set.* (2) *For windings of the A.T.I. and reaction coil with No. 26 for wavelengths of 300 to 3,000 metres.* (3) *A few stations he should get.*

(1) A circuit as shown is correct, but a two circuit receiver would be freer from re-radiation and more selective. (2) A.T.I. 9″ × 7″ of No. 26 with a slider; reaction coil 6″ × 4″ of No. 26 with three or four tappings. It would be desirable to have separate coils for the short wavelengths. (3) You should be able to get almost any of the larger European stations up to 5,000 metres. (4) A list with times of transmissions, see January 7th issue.

**"TYRO" (Catford)** *asks for winding for a coil suitable for 8,000 metres and a condenser of 0·002 mfd.*

If the condenser is used in parallel with the coil for the longer wavelengths, 8″ × 6″ of No. 26 will be sufficient.

**"C.W.R." (Bloemfontein)** *asks* (1) *A question about certain coils.* (2) *How to test a crystal.* (3) *If the substitution of the potentiometer method for the grid leak and condenser method is worth the extra expense.*

(1) You might try the next larger with A.T.I., and the next smaller as reaction coil. We cannot advise you further without knowing the size of your tuning condenser. (2) Buzz some part of the receiving circuit, listen in the telephones, and adjust until the desired sensitivity is obtained. (3) As a rule this is of no extra expense, but there is little to choose between the methods. Broadly speaking, the condenser method is more sensitive and the potentiometer method more stable in operation.

**"J.W." (Walthamstow)** *asks if a sample of wire is suitable for an aerial.* (2) *What times and on what wavelengths telephony is transmitted.* (3) *For a single-valve circuit.* (4) *What stations have the call signs of* **GSS** *and* **PST.**

(1) No. As the wire is steel it is quite unsuitable. (2) Excluding **2 MT** and **PCGG**, the only stations working regularly are air stations on a wavelength of about 800 metres. Times of transmission irregular. (3) See Fig. 2, page 811, March 18th issue. (4) We do not know.

**"C.N." (Merton Park).**—For the information you require concerning the Moscow tune signals, see the issue of April 22nd.

**"J.G.C." (Ealing)** *asks where to obtain information about* (1) *Intervalve transformers for wavelength range of 400 to 4,000 metres.* (2) *Honeycomb coils.* (3) *How honeycomb coils should be mounted relatively to each other.* (4) *Where design of a three valve panel has been given.*

(1) The only way to obtain such a range with one



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pair of coils is to use high resistance winding untuned. The transformer is described on page 781. If wound with No. 47 Eureka wire instead of that specified should be about right for this range. (2) A description of these coils is given in the issue for October 30th, 1920, and a simple machine for winding them, with illustrations of the coils, is described in the issue of July 23rd, 1921. (3) They may conveniently be supported in line on a rod of insulating material. (4) We do not think that a set of exactly this type has been described in detail—the nearest approach being the frame aerial set of Nos. 16 to 21, Vol. VIII.

**"W.J.F." (Hornsey).**—(1) The coils might be used for a wavelength of about 7,000 metres. The larger coil as A.T.I. and the smaller as reaction coil. (2) A.T.C. 0·0015 mfd. with a condenser of 0·001 mfd. across the telephones. (3) Yes, but omit the variable condenser in the plate circuit and put a condenser across the telephones as above. (4) **PCGG** is the call sign of the station transmitting the Dutch Concerts, which you might hear with very careful adjustment.

**"T.P." (Sunderland).**—It will be best to run the aerial from your receiving room as far away as possible from all the buildings, using a single wire, but failing this you might run it across as a double wire aerial stayed out from the house to a pole on the roof above the point marked "pipes."

**"J.W.O." (Hull)** *asks* (1) *For criticism of a circuit.* (2) *How to avoid oscillation when receiving telephony.* (3) *How much of a certain foil and paper condenser will be required for a capacity of* 0·002 *mfd.*

(1) The circuit is O.K. (2) Firstly, by weakening the reaction coupling, and if this fails, by rearranging the leads so that the grid leads of each valve are as far away as possible from the plate lead of the same valve. (3) Two foils about 3″ × 4″ will be sufficient.

**"VALVE" (Bristol)** *asks* (1) *For help with a set which "howls" badly.* (2) *If addition of H.F. valve in the manner shown would be satisfactory.* (3) *If he should get American stations with the H.F. valve added.*

(1) Three stages of L.F. amplification generally do give trouble in this way, and matters are not helped by the use of H.R. telephones directly in the anode circuit. We should recommend you to get rid of one stage of L.F., or to try reversing some of the windings, separating them as far as possible apart or shielding them in closed iron boxes. (2) Yes, over the range you specify. (3) Yes, under favourable conditions. Little would be gained by using a separate battery for the H.F. valve, but this might be done if desired. V. 24 valves can be used for the H.F. but are poor rectifiers.

**"C.M." (Cwnbryn)** *asks questions about an amplifier.*

(1) Filament resistance will be sufficient for the two H.F. valves. (2) Two H.F. transformers will be required unless resistance capacity methods are used. (3) Connect the output of the H.F. amplifier to the grid and filament of the detector panel. (4) The H.F. connections, see Fig. 5, page 813, March 18th issue.

**"PERPLEXED" (Brighton)** *submits a circuit and asks* (1) *For criticism.* (2) *If it could be improved for telephony.* (3) *For a diagram of a three valve amplifier.*

(1) Except that your H.T. battery is shown short circuited, which is evidently a slip, the circuit is quite all right. (2) Only by use of a loose coupled circuit for greater selectivity. (3) See Fig. 3, page 674, January 31st issue.

**"E.F.T." (Tulse Hill)** *asks* (1) *If capacity reaction can be employed with a single valve receiver.* (2) *If so, for the best circuit.* (3) *For values of condensers required.*

(1) Yes, but it is liable to give very erratic results. (2) Can be used with any circuit by the introduction of a small condenser between the grid and the plate. (3) Quite a small condenser is necessary, say about 0·00005 mfd.

**"H.B.D.W." (Oswestry)** *asks whether messages could be received with aerial at right angles to twenty lines of telegraph wires, no signal being obtained when the aerial is parallel to the wires.*

Conditions would certainly be more favourable, but the absence of signals with the aerial in any other position seems to suggest that there is something wrong with your set itself.

**"B.S." (Darwen).**—(1) The loose coupler for Fig. 2 might have primary 10″ × 6″ of No. 22 and secondary about the same size. (2) Double headpiece telephones would be preferable. (3) None of these circuits are very good. No. 12 or 13 might receive **PCGG.**

**"J.M.M." (Nottingham)** *asks* (1) *For criticism of an aerial.* (2) *If ordinary Low Resistance telephones can be used with a Telephone Transformer for the reception of wireless signals.* (3) *How capacity of condensers may be calculated.*

(1) There will be a certain amount of screening if the factory roof is of metal, but this should not be very serious. (2) As a rule ordinary telephone receivers have too low resistance for satisfactory wireless work. Some results could doubtless be obtained with a transformer specially wound to suit the telephones in question. (3) Formula for the calculation of different types of condenser will be found in Nottage's "Calculation of Capacity and Inductance," published by the Wireless Press.

**"E.H." (Battersea)** *asks* (1) *If constructional details for a frame set for the Dutch Concert have appeared in recent numbers.* (2) *If* 150 *ohms marked on Sullivan telephones refers to each earpiece.*

(1) Not very recently, but a set suitable for the purpose will be found described in Nos. 16 to 21 inclusive of Vol. 8. (2) No, this is the total resistance; each earpiece being 75 ohms in the case of telephones of this make.

**"WIRELESS MAD" (Crofton Park)** *has a crystal set which gives no results.*

The set can only give very poor results as shown. Aerial should be of copper not steel. Secondary circuit should be tuned by means of a small variable condenser. We cannot state resistance of the telephones. There is no simple way for you to measure it without instruments. The windings of the circuit are only suitable for about 600 metres. The simplest way to add a valve would be as L.F.

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amplifier, but this is useless with the present arrangement.

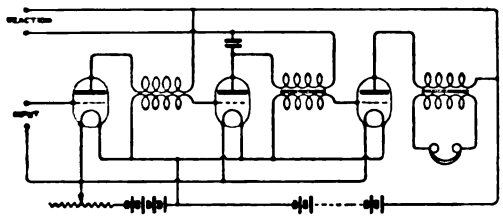
**"P.E.M.E." (Bambury)** *asks* (1) *If the connection of the grid and negative side of filament of a note magnifying valve to the telephone terminals of a crystal set is correct.* (2) *If a diagram is correct.*

(1) Yes, the set should be quite satisfactory. (2) Yes, except that there is no connection from the negative 6-volt battery to earth. If "R" valves are used about 100 volts H.T. will be required, because of the high value of the anode resistance.

**"F.H." (Rayton)** *asks about a frame aerial set for receiving the Dutch Concerts.*

For satisfactory results you will want about five valves with H.F. transformer coupling, the natural wavelength of the transformers being about 1,000 metres. This with a frame four feet in diameter. With an attic aerial of parallel wires joined to the set at one end you will probably get equivalent results with about one valve less.

**"N.E.K." (Malines)** *asks questions about a three valve amplifier for 200 to 2,000 metres receiving set.*



*Fig,* 1.

Two H.F. valves and one L.F. valve is a good arrangement but efficient coupling over the whole range is very difficult with either resistance capacity or transformer coupling. The former is inefficient below 1,000 metres, and the second method will not give a wide range with a single set of transformers. For best results you should use transformer coupling with separate transformers for 400, 600, 1,000 and 1,600 metres. For circuit see diagram (Fig. 1). L.F. intervalve transformers may have any ratio between about 1/1 and 1/3.

**"W.V.R." (Bristol)** *has a crystal set on which only a breathing sound is heard and asks for advice.*

The circuit is correctly arranged and should give signals from ships. The breathing sound is probably caused by the crystal being defective or else by a bad contact in the closed circuit, in either case allowing a slightly unsteady current to pass through the telephones. Try a fresh crystal and examine the wires carefully.

**"A.G." (Teddington)** *asks* (1) *Where to obtain good ink for a syphon recorder.* (2) *Where to get tape for a recorder.* (3) *The approximate capacity and inductance of an aerial sketched.*

(1) and (2) From dealers in telegraph apparatus or from Messrs. Waterlow Bros. (3) Capacity about 0·0001 mfd., inductance 50 mhys.

**"H.F.M." (Bilston)** *asks for the values for the construction of a circuit shown on Fig.* 4, *page* 561, *December* 10*th issue.*

This is not a straightforward circuit, and is only suitable for experienced workers. It is not possible to give suitable values for the capacity and inductance of parts without experimental test. We advise a simple circuit upon which experiments can be made as experience is obtained.

**"C.D.H." (Leigh-on-Sea)** *asks* (1) *If diagram enclosed is correct for a three valve set.* (2) *What voltage to use with "V 24" and "R" valves.* (3) *Which is the better of two circuits for telephony.* (4) *If H.F. transformers are suitable for* 1,000 *ms.*

(1) The resistance R1 should be so connected as to control the L.F. mag. filament in addition to H.F. mag. and detector. Otherwise the circuit is O.K. (2) This is rather a bad arrangement of valves. 30 volts for the "V 24" will probably not be sufficient for the "R" type L.F. valve, while 50 volts for the "R" valve will not give any appreciable increase of signal with the "V 24" valves in the present circuit. Substitute a "V 24" for the L.F. magnifier and use 30 volts. (3) The circuit enclosed will give very good results. (4) It will probably give signals but we cannot say if it is most efficient on that wave without experiment.

**"P.W.B." (Kilburn)** *asks* (1) *If* 30 *volt valves may be used in a* 3*-valve receiver designed for use with* 70-100 *volts.* (2) *If* 15 *volt valves will also do.* (3) *If* 2·2 *volt Hart cells are good for filament lighting.* (4) *Best type of aerial to use.*

(1) and (2) If this is a resistance amplifier the anode resistances will most probably be of too great resistance, but they should be tried out. If L.F. set, the transformers will not be the most efficient for the type of valve, but the set will probably work quite well. (3) Two or three of such cells joined in series will be suitable, provided they are of sufficient capacity. (4) An outdoor aerial will give better results from a frame.

**"B.H." (Mansfield)** *asks* (1) *For the address where iron bands for magnetic detectors may be obtained.*

Probably about the only place where you will obtain these bands is from the Marconi Company, who are the makers of almost all the magnetic detectors still in use.

**"RADIO" (Southend)** *asks* (1) *The wavelength of a crystal set.* (2) *Size of the foils for the condenser for bridging* 2,000 *ohms telephones.*

(1) Maximum wavelength 2,000 metres. (2) The capacity required is about 0·001 mfds. Make Tinfoil into strips ½" wide, and allow 1" of overlap between plates of opposite polarity. The mica dielectric should be 0·005" thick, and 12 tinfoils in all should be used.

**"E.X.E." (Exeter)** *wishes to alter a "Tb" amplifier to use with an* H.P.R. *receiver.*

We regret that we have no diagram of this receiver, and therefore cannot say what alterations, if any, are required. Consult the makers of the receiver, who can probably give you the required information. If the 3 valves do not howl with a crystal, they should not do so with a rectifying valve. On one valve the **2 MT** telephony would probably be weak, but you should certainly hear it.

**"THEORIST" (West Wratting Pash)** *asks* (1) *For L.F. intervalve transformer windings.* (2) *A*



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*question regarding an instrument for measuring the distance between two plates by means of valve oscillators*

(1) On a ½" diameter core of soft iron wires, 3" long, wind 10,000 turns of No. 44 S.W.S. for the primary, and 15,000 turns of the same wire for the secondary. The primary and the secondary should be wound over one another, with a layer of insulating material between. (2) We are afraid the use of a single valve for this method is quite impossible, as for successful working elaborate precautions have to be taken to prevent the two oscillating circuits from reacting on each other, and the common valve to which you propose to connect them would introduce far too much coupling between them. In practice it is very difficult to induce one valve to make two separate H.F. circuits oscillate independently. In almost all cases the whole system starts oscillating as a one unit with a single frequency determined by the whole of the apparatus in use.

**"BEGINNER" (Brighouse)** *asks* (1) *For a criticism of a 2 valve set.* (2) *If further information regarding this set would have been useful.*

(1) With the exception that the 0·001 mfds. bye-pass condenser across the anode winding of the L.F. transformer has been omitted, and also the filament resistance, the circuit is O.K. (2) Information regarding the size of the coils and the capacity of the A.T.C. would have been useful in estimating the correct proportion of A.T.I. and reaction for the oscillator.

**"E.G.B." (Sunderland)** *asks* (1) *If the zincite-copper pyrites crystal combination requires a battery and potentiometer.* (2) *Wavelength, etc., of a crystal set.*

(1) No, it is unnecessary. (2) The wave range with the present set would be up to 4,800 metres. The wire, No. 28, is too fine for an aerial circuit without reaction. The former should be rewound full of No. 24, which will reduce the maximum wavelength to 3,200 metres; just sufficient for time signals. At your distance careful adjustment of crystals will be necessary. Connect a 0·001 condenser across the telephones, which will be quite satisfactory.

**"W.A.N." (Petersfield)** *asks* (1) *Why the two large slabs of a certain set cannot be made to oscillate.* (2) *How to make an ex-Army transformer and Brown 120 ohms telephones as good as 4,000 ohms telephones.*

(1) There is probably not sufficient reaction coupling for oscillation, with the considerable resistance these coils will probably have. Also the coils may be defective, owing to having a few turns short circuited. You might try interchanging the coils. (2) There should not be very much difference between the arrangements, but what difference there is cannot be altered. An improvement will be obtained if a small condenser of 0·0005 mfds. is connected across the H.R. winding. We presume you connect the telephones to the L.R. winding of the transformer.

**"L.J." (Trondheim)** *asks for a single valve diagram to use with slab inductances for telephony and also for telegraphy.*

In the March 4th issue several single valve circuits are shown. Any of these will be suitable for telegraphy, but for telephony you will probably require more valves unless there is any work being done near to you, in which case the sets referred to will be satisfactory.

**"A.D." (Dumfries)** *submits a diagram of a two valve transmitter and asks for criticism and suitable windings.*

This diagram is of unsuitable type for small powers, and is also incorrect. The circuit shown on page 774, March 4th, Fig. 1, will be found more suitable and easy to work. For 1,000 metres the A.T.I. should be 4" × 8", wound full of No. 20. The best value for reaction should be determined experimentally. For a start try a 3" × 5" coil of No. 24.

**"G.H.V." (Shrewsbury)** *refers to Marconi Type 16 Receiver and asks* (1) *How to convert to a two-valve set.* (2) *Windings for a tapped H.F. transformer from 180 to 6,000 metres.* (3) *What is the intensifier of this set.*

(1) Rearrange as in diagram (Fig. 2). Note change of aerial condenser. (2) We are afraid such windings can only be determined by experiment and in any case strongly advise you not to attempt to cover so big a range on one transformer. (3) This is the coupling coil between the aerial and secondary circuits.

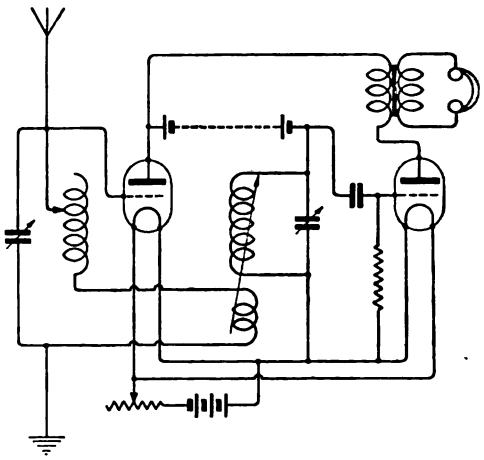

*Fig. 2.*

**"CURIOSITY" (Cambridge)** *asks* (1) *For size and windings for a frame aerial from 85 to 30,000 metres.* (2) *Best method of radio-frequency coupling.* (3) *What extra payments are necessary for having a portable set as well as a fixed set.* (4) *If permission can be obtained to use an aerial with more than 140 ft. of wire.*

(1) A satisfactory 7-valve amplifier for such a range is almost an impossibility. Moreover several frames would be required, the smallest having, say, 6 turns, 3 ft. diameter, and the largest 60 turns, 5 ft. diameter, with suitable loading coils. (2) For wavelengths above 1,000 metres resistance capacity coupling is the simplest to use. Below 1,000 metres use interchangeable transformers. (3) If a separate licence is issued in respect of the portable set you will presumably be required to pay an additional fee. (4) We cannot express an opinion

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and we would advise you to write to the P.M.G., stating the special circumstances warranting such a concession.

**"POLYGON" (Windsor)** *asks if a loading coil would improve a single valve short wave set.*

A loading coil would increase the wave range and would therefore probably be an improvement. It will be necessary to alter the reaction coil at the same time. We cannot give sizes as you supply no particulars of your present set.

**"C.S.M.D." (Catford)** *asks how to connect a telephone transformer in a single valve circuit.*

Connect the H.R. winding with a 0·001 mfd. condenser across it, in the anode circuit between the positive of the H.T. battery and the reaction coil.

**"ARCHANGEL" (Kennington)** *asks* (1) *Wavelength of set.* (2) *Loading coil for* **FL** *and* **POZ.** (3) *Why he hears Croydon but not Lympne.* (4) *Suggestions for improvements at small cost.*

(1) Aerial circuit 2,200 metres, secondary circuit 1,700 metres. (2) For both circuits make loading coils 5″ × 7″. Wind aerial coil with No. 24 and secondary coil with No. 28. (3) Croydon being strong and near does not require a very sensitive set. Lympne, however, being so much further away will probably require an extra valve. (4) The next improvement would be to add a valve as a L.F. amplifier.

**"H.C.E." (Willesden)** *asks* (1) *If a single valve circuit is correct.* (2) *If* **PCGG** *will be received on one ORA valve.* (3) *What is the cause of humming in a crystal circuit.*

(1) The circuit appears to be intended for the Armstrong regenerative circuit, but is not correct. The correct arrangement of this circuit would be as in diagram (Fig. 3). (2) Yes, with a carefully adjusted reaction circuit, but for good readable speech two or more valves is desirable. (3) This is probably due to the circuit arrangement. Connect the aerial side of the telephones as shown in your circuit to the earth side of the blocking condenser.

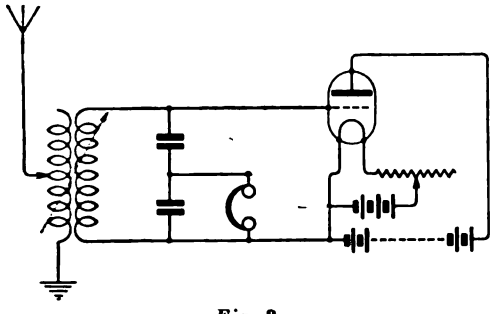

*Fig. 3.*

**"J.R.B." (Scunthorpe)** *asks* (1) *If sample of wire is suitable for crystal set.* (2) *Apparatus necessary for receiving spark and telephony.* (3) *Which of several crystal combinations is most suitable.*

(1) Wire is No. 36, which might be used for the secondary circuit, the size of coil depending on the condenser available. (2) A crystal set is only useful for short distance telephony. At least two valves are desirable for good results. For spark work you will obtain fair results from either of the circuits shown on page 585, December 10th issue. (3) Carborundum is the simplest and most reliable, but zinc-bornite is very sensitive.

**"RUBBER COVERED" (Ealing)** *has a three valve set on which he does not receive telephony.*

With a rectifier circuit and two L.F. valves it is essential that the rectifier should work pretty efficiently. Be sure that the grid condenser and leak are satisfactory, and do not allow the set to oscillate. Connect a 0·001 mfd. condenser across the anode winding of first transformer. Most telephony is on about 900 metres, to which the No. 100 coil does not tune the aerial. The No. 200 coil is the correct one to use.

**"S.W.H." (Colchester)** *asks for criticism of a three valve set and suggestions for improvement.*

The set shown is quite good and the results obtained satisfactory. It would, however, be better to introduce leaks of about a megohm each between the grids of the second and third valves and earth. Another improvement might be the substitution of telephone transformer, preferably with L.R. telephones, in place of H.R. telephones shown.

**"C.J.P.S." (Holland Park)** *submits a circuit which he proposes to use with an indoor aerial of four wires of 10 feet long. He asks for criticism and the size of certain condensers.*

The circuit shown is of a freak type which we greatly dislike, involving as it does the raising of the filaments to the full potential of the H.T. battery with no provision for locating the grid potential at the proper point of the characteristic. Results might be obtained if the leak resistances of the various parts of the circuit happen to be about right, but we strongly recommend a more normal type. In any case more than one valve would be necessary for results with such a small aerial, which would be better replaced by a large frame.

**"BEGINNER" (Dulwich)** *sends a diagram and asks* (1) *Value for grid condenser and leak and* (2) *Value for variable condenser.* (3) *The most distant station he is likely to obtain.* (4) *If there is a better set of this type.*

(1) About 0·0005 mfd. and 1 megohm. (2) 0·005 mfd. (3) The coils are undesirably small. Use the present A.T.I. for reaction and make a new A.T.I. 8″ × 5″ of No. 26. You should then get any European station up to about 5,000 metres. (4) No, but a condenser across the telephones would be desirable.

**"W.B." (Cheltenham).**—(1) Put the microphone transformer in the grid circuit between the variable condenser and the grid leak condenser. (2) Transmission will be C.W. with a superimposed note of the frequency of the coil break. It will probably heterodyne all right, but would be audible at short distances on a crystal. We do not think a choke would improve matters much. (3) For a 30 mile range reception should be as for C.W. (4) Use about 4″ × 3″ of No. 22 with a series condenser, and reaction coil 3″ × 2½″ of No. 28

**"J.D." (Wandsworth)** *asks what gauge wire should be used for H.F. transformers; what resistance the winding should have; if the coils should be wound in opposite directions; what wire to use for an air cored slab transformer.*

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The windings depend on the wavelength required, which you do not specify. In general about No. 40 copper should be used, or finer for a long range. Resistance is immaterial, the wavelength produced by the coils being the important point. If both windings are in the same direction the terminating ends should be taken to plate and grid and starting ends to H.T. + and L.T. − respectively.

**"BEGINNER" (Newark)** *asks* (1) *If two circuits are correct.* (2) *If a condenser should be used across the telephones on a crystal set.* (3) *If it is better to use a small double slide inductance or a long single slide.* (4) *What "mhys." stands for.*

(1) First circuit, yes. Second circuit, yes, either with one end of the inductance left free as shown, or with this end connected to earth for longer wavelengths. (2) Yes. (3) We cannot say without knowing the sizes of the two coils. In general the single slide coil will do all that is required. (4) Microhenries, a convenient practical unit of inductance.

**"E.J.M." (Repton)** *asks for further information about the article on simultaneous H.F. and L.F. amplification in the issue of December 10th, and for advice on working these circuits.* (2) *If we can give the address of the author.*

(1) We are afraid we have not space to treat this subject at any further length. Circuits are all quite sound and you should have no difficulty, particularly with Nos. 2 and 5. These circuits are, however, complicated and need much patience to arrive at satisfactory proportions for all the parts. (2) Referred to Editor.

**"BUZZER" (Bishop's Stortford)** *asks* (1) *Probable reason for failure of the filament of an "R" valve after a week's careful use.* (2) *If it would improve reception to break metal stays to a mast with insulators.* (3) *Windings for a telephone transformer for 8,000 ohm telephones.* (4) *Capacity of a condenser.*

(1) We cannot say. Probably a defective length of filament. (2) Not very much with such very short stays. (3) Use a closed iron core with about 10,000 turns of No. 44 for each winding. (4) Your spacing of ·3 mm. seems very small, but if this is correct the capacity will be about 0·0006 mfd.

**"H.S.T." (Huddersfield)** *refers to page* 103, *May 14th, and page* 427, *October 1st, and asks* (1) *How the two circuits could be used together.* (2) *If the Dutch Concerts could be heard on this combination.* (3) *If the result will be satisfactory on* 100 *cycles.* (4) *If on page* 103 *two variable condensers and two variable inductances will be required.*

(1) Couple the two units by means of a small coil in the aerial circuit, coupling inductively with the coil L, shown on page 427. (2) and (3) The induction hum will be very much more serious on 100 cycles than on 50. So much so, that we are afraid it will prevent you from getting useful results with **PCGG.** (4) Two variable condensers, say, 0·0005 mfds. each, and two inductances, not necessarily variable.

**"JOHNIE" (St. Leonards)** *asks* (1) *For particulars of a single valve receiver with range to* 24,000 *ms.* (2) *If a transformer with a ratio of* 70/1 *may be used with* 120 *ohm 'phones.*

(1) The circuit should be that shown in Fig. 2, page 811, March 18th issue. To cover such a range you will have to use a set of honeycomb coils, the smallest having about 30 turns, and the largest about 1,000, with a mean diameter of about 3". (2) A more usual value is about 7/1, and 70/1 is hardly likely to be efficient. You might try it, if the resistance of the L.R. winding is not less than about 30 ohms.

**"CORONA" (Whetstone).**—(1) The circuit will be fairly good, except that a reaction coil will be a very great help in the reception of **PCGG.** It would also be much better to tune the grid circuit. (You speak of a reaction coil, but you do not show one.) (2) Bring down lead from end of wires. Doubling the down lead is almost immaterial. You omit to say how long the spreaders are. (3) A useful H.F. transformer is described on page 781, March 18th. Data for L.F. transformers have been given several times recently.

**"E.P." (Guildford)** *asks* (1) *If French valves could be used instead of "V 24" valves in the four-valve amplifier, described in October 30th, 1920, issue.* (2) *In what issue the construction of a* 0·0015 *mfds. condenser was described.* (3) *Whether a system sketched for filament lighting with separate resistances to each valve is correct.*

(1) Yes, if additional H.T. voltage is used. About 100 volts will be desirable is "R" valves are used. (2) August 21st, 1920. (3) Yes.

**"N.M." (Gosport)** *asks* (1) *If, when a former is wound with equal numbers of turns of wire of two different gauges, the inductance will be the same in the two cases.* (2) *If halving the number of turns of wire on a coil will halve the inductance.*

(1) No, the coil with the finer wire will have the bigger inductance. To a first approximation the inductances will be inversely proportional to the distance along the former occupied by the winding. (2) No, again to a first approximation, halving the number of turns will give a quarter of the original inductance.

**"R.S." (Herne Hill)** *asks*, re *Fig.* 4, *page* 526, *November 12th,* (1) *The value of the capacity across the transformer winding.* (2) *If a variable* 0·0005 *mfds. in this position would assist tuning.* (3) *If the filament lighting switch could be combined with the throw-over switch in a manner sketched.*

(1) and (2) About 0·001 mfds. is a normal value. The variable condenser might be used if set at near maximum, but it would not assist tuning. (3) Yes, except that it would be better to arrange for the switch, also to cut out additional resistance when the second valve is introduced, otherwise the first valve will light up too brightly when the second is switched off.

**"J.J.J." (Wanstead)** *asks the respective merits of slab, basket, lattice and solenoid coils.*

The solenoid type is the easiest made and is highly efficient. Considerations of size make it undesirable above about 5,000 ms. Basket coils are about the same in efficiency, more trouble to make and not mechanically as strong. They are more compact, but their limit of usefulness is probably about the same as for solenoids. Slab and lattice coils are not quite as efficient as the former types, but considerations of size and expense make their use almost necessary above about

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5,000 ms. Of the two, the lattice coils, if properly made, are the better, but they are rather more liable to defects in winding.

**"SPARK" (Hanwell)** *submits a circuit for criticism, and asks* (2) *Whether it would receive* **PCGG** *with two additional stages of L.F.* (3) *Windings for* 1,500 *ms.* (4) *Capacity of the variable condenser.*

(1) This circuit is, to the best of our knowledge, unique. It may be best described as a crystal set with reaction supplied by a valve. It should receive C.W. as well as spark. While theoretically interesting, it cannot be regarded as an efficient way of using a valve and a crystal. (2) We should not care to say, but it is possible that it might. (3) A.T.I. About 7″×5″ of No. 22. Reaction coil 5″×3″ of No. 28. (4) 0·0005 mfds.

**"ELECTRON" (York)** *asks where to purchase poles or masts for a wireless installation.*

For the small masts usually required for amateur work we should advise consulting a local builder. McGuire hollow spar masts are very suitable for erection on a roof, owing to their lightness. The necessary tackle can be supplied by various of our advertisers. Larger masts of various portable or semi-portable types could probably be supplied complete from stock by the Marconi Company, but may be costly dimensions.

**"P.N.P." (Redditch).**—(1) There is very little difference between the circuits, but we should rather prefer "A." (2) Windings and condenser should be as for **"SPARK" (Hanwell)** above. We should strongly advise you to buy the condenser, as the construction of a good variable condenser is not an easy job for a beginner. (3) Apply to the Secretary, G.P.O., London, furnishing sketch of the circuits to be used, with approximate dimensions of the parts. The licence costs 10s. per annum.

**"A.S.W." (Forfar).**—An article on the conversion of the Mark III tuner for use as a single valve set with reaction was published in the issue for June 25th, 1921.

**"H.P." (Cobham)** *asks* (1) *For criticism of two sets.* (2) *For their wavelength range.* (3) *Size of the reaction coil for one of them.* (4) *Winding for a filament resistance for one valve.*

(1) In crystal set, connect bottom of A.T.I. to earth, slider to aerial and top to condenser and crystal. Valve set is O.K. (2) Up to about 4,000 ms. in either case. (3) 6″×3″ of No. 28 or No. 30. (4) Three yards of No. 22 "Eureka" wire, wound on a former, preferably of slate, about 1″ in diameter, with a good slider.

**"R.B.B." (Prescot).**—(1) The circuit shown is quite correct. (2) Make the reaction coil 5″×4″ of about No. 28, to slide or the A.T.I. (3) The 'phone blocking condenser need not be variable. (4) The 'phones should have a resistance of not less than 4,000 ohms.

**"A.F.A." (Woolwich).**—(1) The circuit is quite correct. (2) Either because the value of the grid condenser or leak is wrong, or more likely because you are allowing the set to oscillate. (3) Exactly as in the circuit shown, connecting as many of the pancakes as may be required in series. (4) The circuit may be as in Fig. 4, page 813, March 18th issue, with the aerial circuit remaining as in your own sketch.

**"W.R.S." (Ely)** *wishes to make a tuner on the lines of the panel tuner in September 3rd issue. He asks* (1) *The best way to increase the wavelength to* 30,000 *metres.* (2) *If any alterations to the set will be necessary.* (3) *Capacity for a series aerial condenser.* (4) *If a series-parallel switch will be useful for condenser.*

(1) It will be necessary to increase all the windings very considerably. We think you will find the attainment of such a range very difficult without the use of either a set of honeycomb coils or numbers of basket coils in series in place of the tapped solenoids shown. (2) No, unless you are using inter-valve transformers in the amplifier, in which case special transformers will be necessary for the longest wavelength. (3) About 0·003 mfd. (4) Yes, if you wish to cover both long and short waves.

**"M.B.B." (Falkirk)** *refers to Fig.* 5, *page* 706, *and asks* (1) *If the circuit will operate on all wavelengths with interchangeable H.F. transformers.* (2) *Suitable size for telephone transformer and condenser for use with* 120 *ohm telephones.* (3) *If extra stages of H.F. and L.F. could be added.*

(1) Yes, except that the switching off of the first valve will no longer be suitable as shown. It will be necessary to rearrange the switch with extra contacts to break the secondary of the first inter-valve transformer when the first valve is not in use. (2) Windings might be 3 ozs. No. 44 and 6 ozs. No. 32 on a core ¾″ in diameter. Condenser 0·001 mfd. (3) Additional stages could be added, but if it was desired to throw the middle out of circuit in the same way switching would become complicated and liable to give much trouble.

**"SEMI-AUTO" (Dewsbury)** *asks* (1) *If it is possible to use* 220 *volt D.C. supply for all the current required for a receiving set.* (2) *Best type of aerial to use.* (3) *How to calculate the capacity of a condenser.* (4) *For a good text-book on telephony, describing the construction of apparatus.*

(1) This could be done, but is undesirable, as the use of a 220 volt supply for filament lighting would be very wasteful and, moreover, the use of mains for either L.T. or H.T. is liable to give unpleasant induction troubles. (2) Either a single wire 100 ft. long, or a twin wire 70 ft. long, may be used. (3) Various formulæ are required according to the type of the condenser. The commoner forms have been given in back issues, and a number are collected in Nottage's "Calculation of Capacity and Inductance." (4) Coursey's "Telephony Without Wires" is a very good general text-book but does not deal with the constructional side. We do not know of any book in which this is at all well treated.

**"H.D." (Manchester)** *submits a circuit for criticism and asks* (2) *For capacity of condenser and grid leak.* (3) *If the circuit will be suitable for* **PCGG.**

(1) The circuit is a variation of the Armstrong regenerative, and we do not think this variation at all likely to work. We should strongly prefer the normal type of circuit as used in this country. We do not think the circuit shown would give **PCGG**, and cannot say whether a grid condenser would be of any use, but we do not think it at all likely.

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**"B.H.M." (Ilford)** *asks for a design for a loud speaker.* (2) *If it is possible to receive* **PCGG** *with one valve.*

(1) See article February 19th, 1921. (2) Yes, but the results are not loud and would be greatly improved by additional amplification. Reaction must be used in any case.

**"R.C." (Godalming)** *asks if, for an amateur making up his own three-valve set for telephony, it is better to have L.F. amplification or H.F.*

The best general arrangement is to have one stage of H.F., followed by detection and then one stage of L.F. Two stages of L.F., followed by a detector is also good, but we do not recommend entirely L.F. except where simplicity of operation is specially desired.

**"J.R.R." (Manchester)** *asks advice about an aerial.*

Your arrangement with tapping No. 2 appears to be the best that can be done, and should give quite good results with a two or three valve amplifier. The part 1 to 2 may be retained, but we should rather prefer to do away with it.

**"AUTODYNER" (Methil)** *asks* (1) *If a circuit is O.K.* (2) *If an aerial of No.* 18 *bare fuse wire will be satisfactory.* (3) *If certain coils will oscillate.* (4) *If the proportions of the parts are all right.*

(1) Circuit O.K. except that it would be better to couple the reaction coil with the closed circuit rather than with the loading coil. (2) This is electrically O.K. but mechanically very poor. The wire is not strong enough for the purpose. (3) Yes, if the rest of your coils are of fairly thick wire. (4) Yes, but we doubt if you will get strong enough signals to work a loud speaker.

**"C.L.B." (Nottingham)** *asks* (1) *For a circuit to add two H.F. valves to a two-valve amplifier.* (2) *For windings for H.F. transformer for* 180 *metres.*

(1) The H.F. arrangement should be as in Fig. 5, page 813, March 18th issue. (2) We are unable to give exact windings, as these should be finally determined by experiment; but you will probably find windings of about 2" long of No. 34 wire on a former 1½" in diameter, the windings being separated by one or two layers of shellac paper, would be about the right value.

**"E.J.W." (Manchester)** *asks* (1) *For a constructional textbook on receiving circuits.* (2) *The wavelength range of the circuit in Fig.* 8, *page* 719, *and that of Fig.* 13, *page* 727. (3) *If these sets would receive American high-power stations.*

(1) We are afraid there is no suitable book in existence, but you would obtain useful information from articles in past numbers. (2) The wave range of these sets depends on size of coils used. The type of Fig. 8 is suitable for all wavelengths, and that of Fig. 13 for all wavelengths above 1,000 metres. The latter set should, however, give greater amplification at long wavelengths. (3) Yes, under favourable conditions, but we should prefer the second set.

**"A.R." (Egham)** *refers to Fig.* 13, *page* 726, *February* 18*th, and asks if a single slide coil would be suitable for tuning.* (2) *Dimensions of the coil for* (a) 1,500, *and* (b) *for* 3,000 *metres.* (3) *For capacity across the transformer.* (4) *Which two of the three valves shown give* **PCGG.**

(1) Yes, but we do not like the method shown of shorting part of the coil not in use. (2) Parallel condenser is not necessary for such small wavelengths. For 1,500 metres, coil might be 8" × 5" of No. 20, and for 3,000 metres 9" × 6" of No. 22. (3) About 0·001 mfd. (4) We do not know which the author used; probably all three. His statement that two were used, is probably a misprint.

**"L.J.V.K." (Rugby)** *asks* (1) *Why a set will not oscillate on short wavelengths.* (2) *If a choke instead of an anode resistance would be an improvement.* (3) *If the set would give radiation troubles.* (4) *If certain windings should give* **2 MT.**

(1) The probable reason is that you have H.R. 'phones without a condenser in series with your reaction coil. Addition of the condenser will probably be sufficient to make your set oscillate. (2) Not appreciably. (3) Radiation is always fairly considerable from a single circuit oscillating set. (4) Yes, but we should much prefer single layer coils of larger size to the pile wound coils shown.

**"W.S." (Chorlton-cum-Hardy)** *has a coupler* 6" × 7½" *of No.* 24, *and* 5" × 6½" *of No.* 28. *He asks* (1) *If the coupler will work.* (2) *If so, to what wavelengths.* (3) *If* 4" × 9" *of No.* 22 *and* 3" × 6" *of No.* 30 *is suitable for concerts.* (4) *How to make a loud speaker.*

(1) Yes. (2) Up to about 3,000 metres. (3) Yes. (4) See an article in the issue of February 19th, 1921.

**"E.H.M." (Bexley)** *refers to Fig.* 1, *page* 430, *October* 1*st issue, and asks* (1) *If S.*1 *and S.*2 *are inductances or resistances.* (2) *For a two-valve winding employing the same principles.* (3) *If either of two arrangements sketched would be suitable.* (4) *If S.*1 *and S.*2 *are resistances, what value they should have.*

(1) Either resistances or inductances would do. Resistances would give you a bigger range of wavelengths. We should advise earthing the middle part of the frame to the negative of the L.T. battery. (2) and (3) We do not think this could be very satisfactorily done for C.W., but for spark your second arrangement would be satisfactory if you added a crystal in series with the telephones. You might add reaction coils in the plate of each valve coupling back to the frame circuit, but we doubt if this would be very effective. (4) 20,000 to 50,000 ohms each.

## SHARE MARKET REPORT.

Prices as we go to press, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 6 | 3 |
| ,, Preference .. .. | 2 | 1 | 10 |
| ,, Inter. Marine .. .. | 1 | 9 | 0 |
| ,, Canadian .. .. | | 10 | 0 |

Radio Corporation of America :—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. .. | | 17 | 3 |
| Preference .. .. .. .. | | 14 | 6 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 6. MAY 6TH, 1922. WEEKLY

## The Johnsen Rahbek Amplifying Loud Speaker

By F. H. HAYNES.

A METHOD of amplification which has not to any extent become popular is that employing the adhesive action between an agate cylinder and a metal face when subjected to a difference of potential. This method, due to Messrs. Johnsen & Rahbek, two Danish engineers, was fully described by Mr. P. R Coursey in his articles on "Loud Speaking Telephones"* and the following gives practical details for the construction of a set employing the principle described.

The agate selected for making the cylinder should be, as far as possible, grainless, and that known as chalcedony, is particularly suitable owing to its homogeneous structure. Should any parallel markings exist they should be such that their plane permits of being arranged at right angles to the axis of the cylinder. Suitable dimensions are given in Fig. 1 (*a*) and it is advisable to purchase a cylinder made to these dimensions. If it is desired to make the cylinder, one must be skilful in the processes employed for working hard stones. In brief, the turning of the outer face is effected by using a lathe tool of copper with a square face of about 2 mm. sides and feeding it with a diamond dust paste. As the paste is applied to the tool it is immediately apparent how effectually it is cutting. The boring of the centre hole is not an easy task and consequently it is advisable to make a smaller hole at first and enlarge it to the final dimension by means of a boring tool such as is used in lathe work for boring a tunnel. The first hole is put through in the lathe by holding the cylinder in the chuck and forcing into it an iron tube of external diameter of the size of the desired hole. A hole is made in the side of the tube for the purpose of feeding the diamond dust, and the tube is driven forward from the point of the back centre. All the precautions have to be taken, of course, with regard to accuracy such as are usual in lathe work. After the hole has been put through it should be secured to a spindle in order that it can be revolved for the purpose of polishing. A piece of wood is prepared with a semicircular hollow face, covered with a strip of sheet lead. Ruby powder is mixed to a paste and is used on the face of the lead, pressed hard against the revolving cylinder. Great care must be exercised to prevent any trace of diamond dust getting into the ruby powder during polishing. The presence of the merest particle will produce scratches that are difficult to get out and if not entirely removed will cause noises in the operation of the finished instrument.

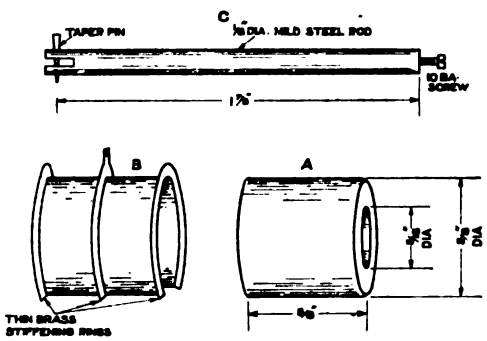


*Fig.* 1.

The design of the shoe is shown in Fig. 1 (*b*). The rubbing portion is of copper and can conveniently be made from a piece of hard drawn copper tube. The inside face must be highly polished and entirely free from scratches, and should be just a slipping fit on the cylinder. Thin brass rings are attached to its ends and middle in order to stiffen it and give even pressure at all points on the inner surface of the copper. These rings can, of course, be soldered on and in the construction of this fitment it should be borne in mind that it must be kept as light as possible without sacrificing any stiffness. The shoe, together with all the other parts which are required to vibrate at sound frequency, must be kept to the smallest mass in order that there may be a minimum of damping. The middle ring has an extension for coupling up a rod which transmits the vibrations to the diaphragm. This rod is shown in Fig. 1 (*c*) and is

* *Wireless World*, Vol. IX., pp. 225, 256, 289, 311 and 371.

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made of mild steel and slotted at its end for making a union with the ring. The diaphragm can be made of mica or compressed silk and the mounting of any convenient pattern, such as is used in the construction of gramophones (Fig. 2).

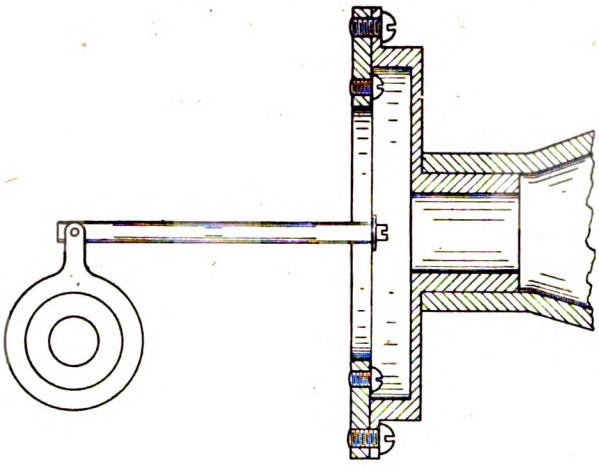

*Fig.* 2.

The cylinder is mounted on a spindle which is a fit. It is essential that the cylinder and spindle make good electrical contact. If there is any difficulty in securing the cylinder, the spindle may be coated with copper by immersion in copper sulphate solution and then evenly and thinly tinned. The cylinder is driven on over the tinning and a good grip effected. Fig. 3 shows the method of setting up the cylinder and a convenient way of mounting the spindle.

The spindle is driven by a worm-gear and if the usual type of small fan motor is used to drive the instrument a reduction gear of 4½-1 on the worm screw and a previous gear reduction of 8-1 gives a convenient running speed, assuming that the motor speed is about 900 r.p.m. It may be mentioned here that clockwork has been tried for the purpose of revolving the cylinder but the writer is not aware of any clockwork on the market sufficiently powerful and it must be borne in mind, of course, that the very large patterns of gramophone motors do not provide more power than the smaller ones, but that they rotate for a longer period on one winding. Fig. 4 shows a convenient lay-out for the driving mechanism.

The instrument can be operated by connection in a valve circuit of a receiver amplifier and the plate circuit battery can be used to provide the polarising voltage, but a better method, when signals are strong enough, is to operate the loud speaker from a microphone, which is coupled to a telephone earpiece. The circuit is shown in Fig. 5. The method of coupling is worthy of attention and Fig. 6 shows a good method of effecting it. The spacing shown proportionately in the figure between the earpiece and microphone should be adhered to, and the fitting of an iris diaphragm is very effective for producing maximum transmission of energy across the air space. It will be found that a certain definite adjustment of the aperture gives maximum amplification.

The polarising voltage can be derived from D.C. public supply mains, or if not available, from the usual H T. batteries. The transformer in the

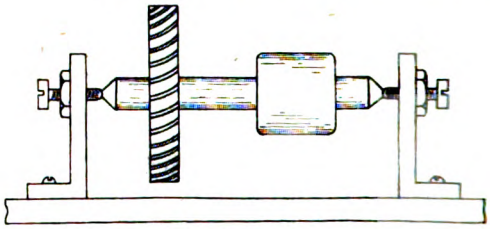

*Fig.* 3.

microphone circuit may be a small spark coil with its contacts screwed up. A variable resistance is connected in the microphone circuit to adjust the current to a suitable value at which the microphone will give maximum results.

This type of instrument is successful for the amplification of telephony as the results it gives

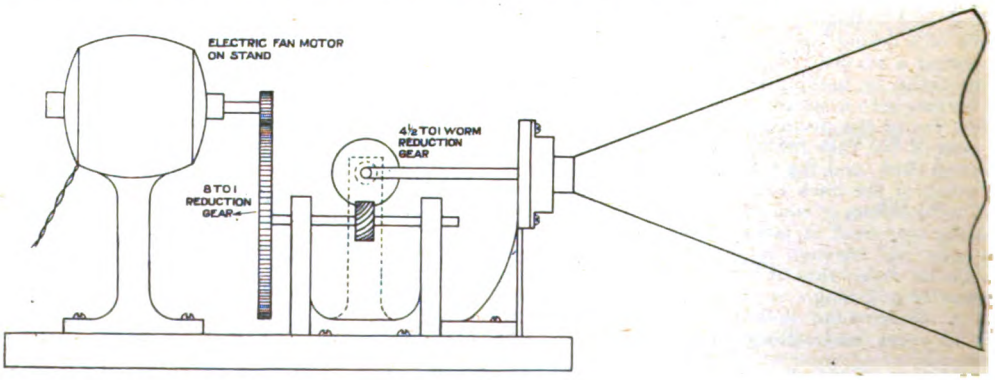


*Fig.* 4.

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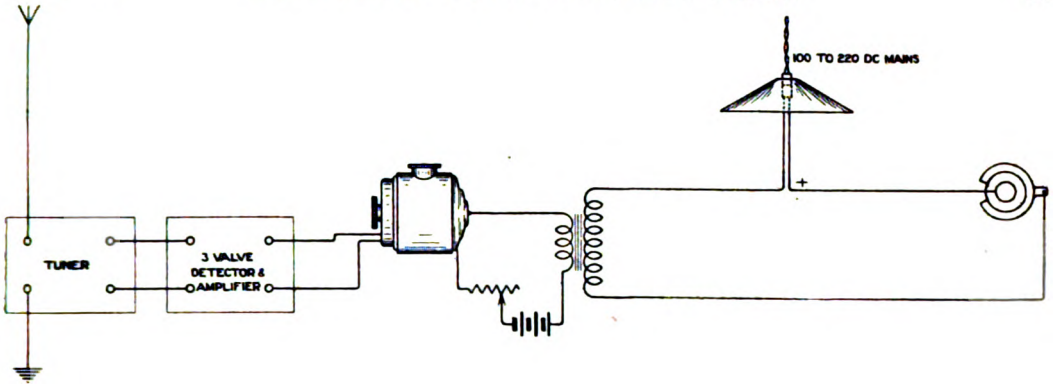


*Fig. 5.*

are entirely free from distortion and, to the author, is the only known method for rendering wireless telephony audible to large audiences. The volume of sound produced is tremendous, and it is essential that the receiver amplifier and microphone gear are not installed in the same room as that in which the loud speaker is operating, as the vibrations set up are so great that not only will they react on the microphone but, also, they will set up mechanical motion in the valve parts which will give rise to very considerable howling.

The vibration imparted to the shoe is sufficiently great to be easily visible and if its movements are sufficiently damped so that a buzzed signal will have an accumulative effect, the outfit can be used for the purpose of recording. A stylus is attached to the rod in place of the diaphragm and signals will produce ripples in a line that it will inscribe on a tape running beneath it.

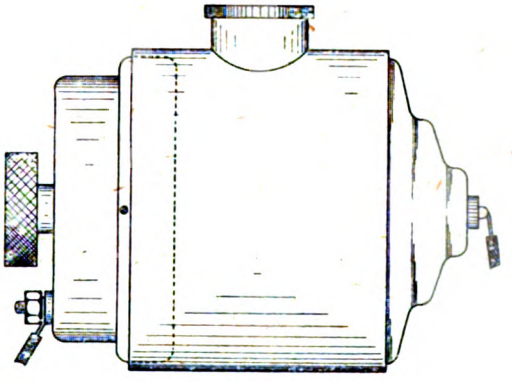

*Fig. 6.*

# On Heterodynes

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

THE general principles underlying the reception of C.W. signals by the heterodyne method are sufficiently well known not to require repetition here, as it is the purpose of this article to describe the main features of some arrangements of separate heterodyne oscillators and to give directions for building simple forms of such apparatus. As is generally well known, the use of a separate heterodyne oscillator as distinct from autodyne receivers in which the oscillations are set up by the detector valve itself using one of the many reaction circuits, possesses several advantages particularly when the longer wavelengths are to be received. With the separate heterodyne, the tuning circuits of the receiver itself can be brought exactly into resonance with the wavelength of the incoming signals, thus minimising loss, while in addition a limited amount of reaction can also be employed to still further strengthen the signals when necessary.

For use as a separate heterodyne it is merely necessary to provide a three-electrode valve with the usual L.T. and H.T. batteries, and appropriate circuits that will enable oscillations to be generated of any wavelength within the range in which it is desired to work. This can of course be done with any of the several types of reaction circuit, given a proper design for the coils, etc., but some arrangements are superior to others as regards stability, ease of adjustment, etc. Another point to be borne in mind is that with some arrangements the waveform of the oscillations is distorted more than it is with others, with the result that a greater number of harmonics will be set up in the former case than in the latter. This may or may not be a disadvantage depending upon circumstances, and to what other uses it is desired to put the apparatus besides ordinary reception.

A very simple arrangement suitable for use as a heterodyne with any ordinary form of receiving

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apparatus can be made up by using a set of any of the well-known interchangeable coils — Honeycomb; Duolateral; Burndept; Pancake or Slab inductances—fitted with plugs, or some equally convenient means of rapidly changing one coil for another. For convenience these coils may be plugged into one of the well-known forms of coil holder, one coil being used with a tuning condenser (variable) to form the oscillation circuit, and the other connected up as a reaction coil, as in Fig. 1.

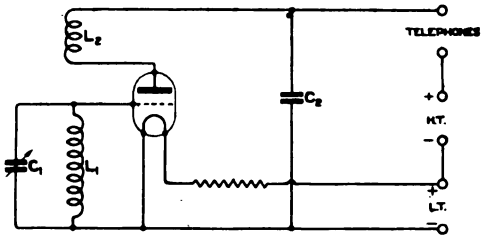


*Fig.* 1.

In that diagram, $L_1$ and $L_2$ are the two coils, referred to as mounted in a two coil holder, and $C_1$ is the variable air condenser for tuning, $C_2$ being merely a blocking condenser. This latter should have a capacity of at least 0·01 microfarad, and should preferably be much larger than this value. Terminals marked "telephones" are shown in Fig. 1 in the anode circuit of the valve. These will generally be joined together by a strap when the heterodyne is used normally, but it is convenient to provide them so that the apparatus can be used for other purposes, and for special tests. Either high resistance telephones can be used, or preferably a telephone transformer can be fitted in the instrument with low resistance telephones. This latter arrangement possesses some advantages besides the usual one of removing the steady direct plate current of the valve from the telephone windings, in that it also removes some of the stray capacity effects which may be produced in the circuit when the telephones are moved about when in use.

The chief disadvantage of an arrangement of this form is that the frequency of the oscillations that are set up depends to some extent upon the relative positions of the tuning and reaction coils, so that it will not be possible to obtain a stable wavelength calibration for the instrument. These changes will be more important the smaller is the capacity that is used in the tuned circuit, as the small stray (and variable) capacities between the coils and the other parts of the circuit will then be a greater percentage of the main capacity. To a limited extent this trouble can be got over by using a fixed form of coil holder in which the distance between the coupling coils cannot be varied as in the usual forms. This, however, introduces a further disadvantage that the separation of the coupling coils must be given some mean value that can be used for all the pairs of coils that it is intended to use with the instrument, and consequently the coupling may be tighter than the optimum in some cases, and looser in others. If the coupling is tighter than necessary there is a tendency to emphasise the amplitude of the harmonics generated by the valve as compared with the strength of the main oscillations of the fundamental frequency. While in many cases this may be no disadvantage—and may in fact be quite useful—in others it may be troublesome and become desirable to avoid. It is, however, difficult to eliminate this effect and at the same time to retain stability of the calibration. Usually constancy of calibration is all important if the instrument is to be used as a form of wavemeter, so that other disadvantages are allowed provided this desideratum can be secured.

The general arrangement of a heterodyne of this type is sketched in Fig. 2, which also shows leading dimensions. By using steps of fixed capacity in parallel with the variable tuning condenser, the effective wavelength range of the instrument can be increased without using an excessive number of coils. When a fixed condenser is in parallel with the variable, the accuracy of setting to any given wavelength can be much increased, since each division of the scale of the variable condenser then corresponds to a smaller percentage change in the total capacity of the circuit, and consequently a smaller change in wavelength. While not of such great importance

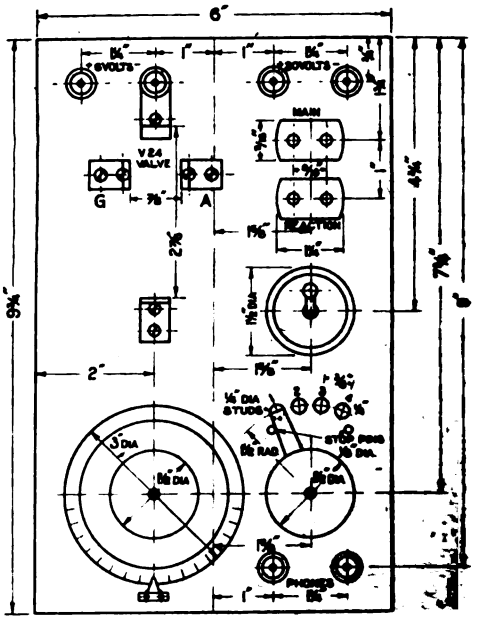


*Fig.* 2.

at the higher wavelengths, this spreading out of the wavelength scale is very useful on the shorter waves, since with these wavelengths the necessary tuning is much sharper as a smaller change in wavelength suffices to take the heterodyne beat note to the upper limits of audition. Using a set of "Burndept" coils, the tuning capacity can be taken up to 0·005 microfarad on each range without any trouble from difficulty in securing oscillations. Using the maximum capacity, it is only necessary to have four coils to cover a wavelength range of about 250 up to 30,000 metres, these coils being

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arranged in pairs so that one serves as the main tuning coil and the other for reaction. The approximate wavelength ranges obtainable are set out in Table I, which gives the coil numbers required in each case :—

TABLE I.

| Main Coil No. | Reaction Coil No. | Wavelength Range (metres). |
|---|---|---|
| 50 | 150 | 250–1,550 |
| 300 | 150 | 1,300– 9,000 |
| 750 | 300 | 4,500–30,000 |

The wavelength ranges given in this Table have been calculated on the assumption that the maximum value of the tuning condenser is as stated above, viz., 0·005 $\mu$F. Although it is possible to obtain variable air condensers having a maximum value of 0·005 $\mu$F, it is not desirable for the purpose of this instrument to do so, as by using a condenser having a smaller maximum value in conjunction with fixed condensers which can be connected in parallel, the ease and accuracy of setting the instrument to any given wavelength is increased. A convenient value to make the variable is 0·0015 $\mu$F, and to use three fixed condensers of values 0·00125; 0·0025; and 0·00375 $\mu$F respectively which can be connected in circuit by a four-way switch. Alternatively three equal condenser units of 0·00125 $\mu$F each can be used with a special switch arranged so that it connects either one, two or three units in parallel with the variable condenser, so as to give the following capacity ranges in each position :—

TABLE II.

| | | |
|---|---|---|
| 0·000100 | (approx.) to 0·0015 | Variable condr. only. |
| 0·00135 | to 0·00275 | Variable + 1 unit. |
| 0·00260 | to 0·0040 | Variable + 2 units. |
| 0·00385 | to 0·00525 | Variable + 3 units. |

There will thus be a convenient overlap on each range so as to avoid gaps in the wavelength scale. As, however, the price of the condenser units, if purchased ready made, will vary very little, if any, with their capacity over the range of values here required, it is often more convenient to give the successive units different values, viz., 0·00125; 0·0025; and 0·00375 $\mu$F, as stated above, so as to enable a simple four-point switch to be used. The connection scheme for the whole instrument will then become as in Fig. 3.

It will be noted that in this diagram, as also in Fig. 2, a holder for a V-24 valve is shown. For heterodynes of this type it is recommended that these valves be used, since it will be found that they give steadier oscillations over the range of capacities here described, and using 30 volts on the plate circuit, than are generally obtainable with most R valves.

Reverting to Fig. 3, it may be noted that a fixed resistance of about 1 ohm is shown inserted in the filament circuit of the valve. With 6 volts on the L.T. terminals such a resistance will give about the correct working voltage on the filament of the valve. The use of a fixed resistance for this purpose is preferable to employing a filament rheostat of the usual type, since the frequency of the oscillations set up by the valve is dependent upon the filament temperature, and upon the plate potential as well as upon the constants of the oscillation circuit. Great care must therefore be taken to maintain these supply voltages as steady as possible if it is desired to obtain a wavelength calibration for the instrument that will be in any degree permanent.

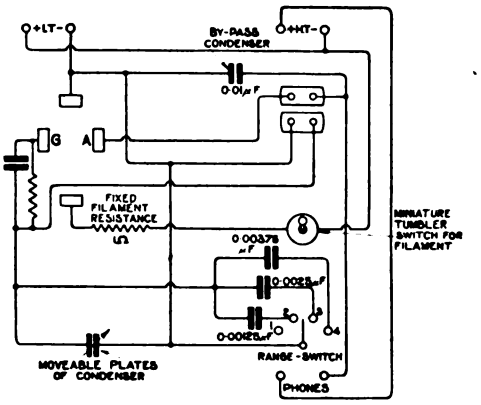


*Fig.* 3.

Another difficulty experienced in operating any form of heterodyne arises from the capacity of the parts of the instrument to the hand of the user. This "hand effect" will be found to depend very largely upon the exact arrangement of the oscillation circuit. This effect can be reduced by arranging the moving vanes of the variable condenser to have the lower potential of the two sides of the condenser—*i.e.*, they should be made the terminal which is joined to the filament of the valve. Similarly the arm of the four-point range switch should likewise be connected to the filament of the valve, since the capacity of the batteries, etc., to earth being large, the valve filament and the parts directly connected thereto will be at the lowest potential of the system and will consequently be least affected by stray capacities to earth. The effect of the capacity of the telephones can be reduced by using a telephone transformer as has already been pointed out.

The general arrangement shown in Fig. 2 is laid out to overall dimensions of 9¾" × 6", so that if mounted as the top of a box 4¾" deep (outside) the instrument will be uniform in style with the short wave heterodyne which has already been described in these columns.* The bulk of the instrument can be assembled from standard parts purchasable from most dealers of wireless apparatus, but for those who wish to build as much as possible of the instrument themselves more detailed dimensions and instructions, will be given in the second instalment of this article, as although similar in function, the dimensions of some of the parts have been somewhat modified as compared with those which were described in the article on the short wave heterodyne to which reference was made above.

*(To be continued.)*

* *Wireless World*, Vol. 9, pp. 461–464, 493–497.

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# Some Experiments in Radiotelephony

By G. PESSION.

1. As is known, in order to produce good radiotelephonic transmission, it is necessary to obtain a generator that will maintain alternating current of constant amplitude and frequency in the transmitting antenna for the radiation of continuous electromagnetic waves of convenient length.

The continuous waves constitute the "carrier" of the radiotelephonic emission and their amplitude and frequency must be modulated by the voice by means of a suitable microphonic device. In the absence of modulation continuous current is produced in the telephone at the receiver, by the known processes of amplification and rectification, but this does not give rise to any sound; it is the variations of the amplitude or frequency of the carrier wave that produce in the telephones the variations of current reproducing the voice or the sounds emitted before the microphone transmitter. The length of wave used in radiotelephony ranges in general from some hundreds to some thousands of metres.

The generators of damped trains of waves following one another at supersonic group frequencies are now entirely discarded.

2. The methods for the production of the carrier wave for radiotelephonic transmission have been much improved by the use of three-electrode thermionic valve generators. This type of generator undoubtedly offers for small and medium powers, exceptional advantages on account of its simplicity, the ease with which it is handled, and the relative purity of the emitted wave that can be obtained with proper precautions. In large power undertakings, high frequency alternators in conjunction with magnetic amplifiers or frequency multipliers are used with success.

In the experiments described below, which were undertaken in the months of May and June, 1921, I used instead the Poulsen arc as generator of the continuous waves. The purpose of these experiments was to obtain in as quick and simple a manner as possible, a good adjustment of the arc for long distance radiotelephony. Hence many of the arrangements employed are not new, but simply the repetition with suitable alterations of experiments already performed by others. However, considering the results obtained in relation to the simplicity of the means employed, it is believed that these experiments, looked at as a whole, will not be found altogether devoid of interest.

3. The Poulsen arc as generally employed in radiotelegraphy is connected directly in the aerial circuit on account of the great simplicity of this arrangement and the relatively high efficiency obtained by virtue of the absence of a primary or intermediate circuit. For radiotelephony, however, an inductive coupling is preferable in order to obtain a greater purity of the emitted wave, and especially also a diminution of the troublesome "rustling" noises, which can be heard in a receiver close to a transmitter employing the direct connection of the arc. In the primary circuit, it is better that the capacity should not be too large, in order to obtain greater steadiness of the oscillations. The coupling should not be too tight. Very good results were obtained with the following constants (Fig. 1):—

$C_1 = 0{\cdot}007\ \mu F.$
$C_2 = 0{\cdot}002$ to $0{\cdot}008\ \mu F.$
$\lambda = 2{,}600$ to $3{,}000$ m.
$\lambda_0 = 600$ to $1{,}900$ m.

where $\lambda$ is the wave emitted and $\lambda_0$ the natural wavelength of the aerial.

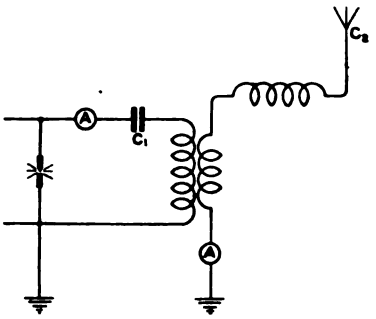


*Fig.* 1.

4. An inquiry was made at first as to what results could be got by using simple carbon microphones. The method shown in Fig. 2 first suggested by Stone, was adopted, using four Kellog microphones in series and coupled inductively to the aerial inductance. The coupling and the number of turns on the coils were regulated so that

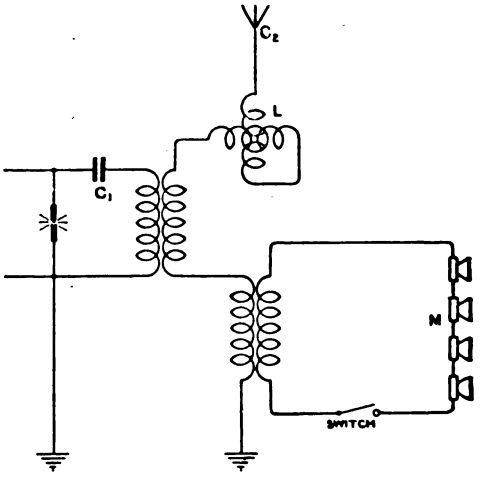


*Fig.* 2.

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on closing the switch the current in the antenna fell to about half its previous value. With four microphones the value of the antenna current with switch closed could be kept at 3 amperes without undue heating.

By suitable regulation of the variometer very good modulation, as recorded by the aerial ammeter, could be obtained, and the voice received by an ordinary thermionic valve receiver was clear and perfect, leaving nothing to be desired as compared with the results obtained with a valve transmitter. With this simple contrivance some tests were carried out between Rome and the yacht *Electra*, belonging to Senatore Marconi. The *Electra* was employing a thermionic valve transmitting apparatus, and good communication up to about 400 km could be obtained without difficulty, by using a receiver of medium sensibility (two valves—one detector and one low frequency amplifier) on an aerial of moderate dimensions.

The principal condition necessary for the success of the experiment is that the four microphones function acoustically in phase and that is secured by having the four tubes carrying the vibrations of the voice to the microphones of exactly equal length. Fig. 3 shows the construction of the multiple microphones actually employed in the tests which were carried out near the Radiotelegraphic Station at Centocelle (Rome). The method of modulation employed is a detuning method, that

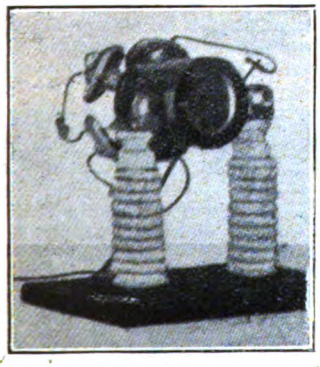

*Fig.* 3.

is to say, the antenna current is modulated principally in consequence of the variations of syntony with the primary circuit that takes place through the variations of the resistance of the microphone circuit. The variations in the resistance of this circuit produce, in fact, changes in the effective inductance of the antenna and hence alterations of tuning.

This is easily seen by observing that when the switch (Fig. 2) is closed, the antenna circuit can, by changing the adjustment of the variometer, be brought back into resonance with the primary circuit, and the original antenna current restored. The functioning of the radiotelephone under conditions of greater or less initial detuning between the primary circuit and the antenna is therefore possible.

It has been maintained, however, that for best working the initial detuning should be such that the working point is not too far removed from the top of the resonance curve, such, for example, as the point marked with a cross in Fig. 4. Under these conditions, when speaking in front of the microphone, there is a perceptible lowering of the effective value of the antenna current.

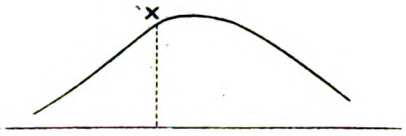

*Fig.* 4.

It is certain that by increasing the number of microphones, even with the simple arrangement just described, results far superior to those above referred to could be obtained, but further experiments were not carried out, as it was thought preferable to have recourse to more powerful methods of modulation by the employment of thermionic valves.

**5.** Various systems were tried with the object of obtaining a suitable modulation of the antenna current generated by the arc. The results showed that it was best to act on the secondary circuit in such a way as to produce simultaneous variations of its wavelength and of its resistance.

An absorption method was therefore chosen constituting a simplification of one proposed by Hund, which has been adopted by several firms in their telephonic apparatus. Several schemes were then investigated, one after the other, and after some trials, the one shown in Fig. 5 was decided upon. This method is very effective and practical, since the transformer T permits of the regulation at will of the voltage applied to the valves and hence the use of types of valve adapted for various voltages. The effect of this contrivance is principally to produce variations in the resistance of the antenna by reason of the shunt to earth constituted by the thermionic valve $V_1$ the resistance of which varies according to the voltage on its grid produced by the microphonic current.

In order to study the working of the set, a curve was plotted out which might be called "the static modulation characteristic," that is, a curve connecting the intensity of the antenna current with the value of the grid voltage of the valve $V_1$. It can be seen from Fig. 6 that as the grid is gradually made positive, the antenna current diminishes on account of the increased absorption and consequent expenditure of energy in the coupled circuit.

Given a relatively low frequency for the telephonic modulation it may be assumed that the static modulation characteristic gives useful information as to the operation of the apparatus when the voice vibrations produce variations in the grid voltage of $V_1$ which are superimposed upon the steady voltage of the battery P, by means of the transformer $T_1$. The best conditions of working were investigated by experiment, and it was proved that the best initial value of the grid voltage is that corresponding to the upper bend of the modulation characteristic so as to have a perceptible lowering of the effective value of the antenna current during speech. Such a lowering

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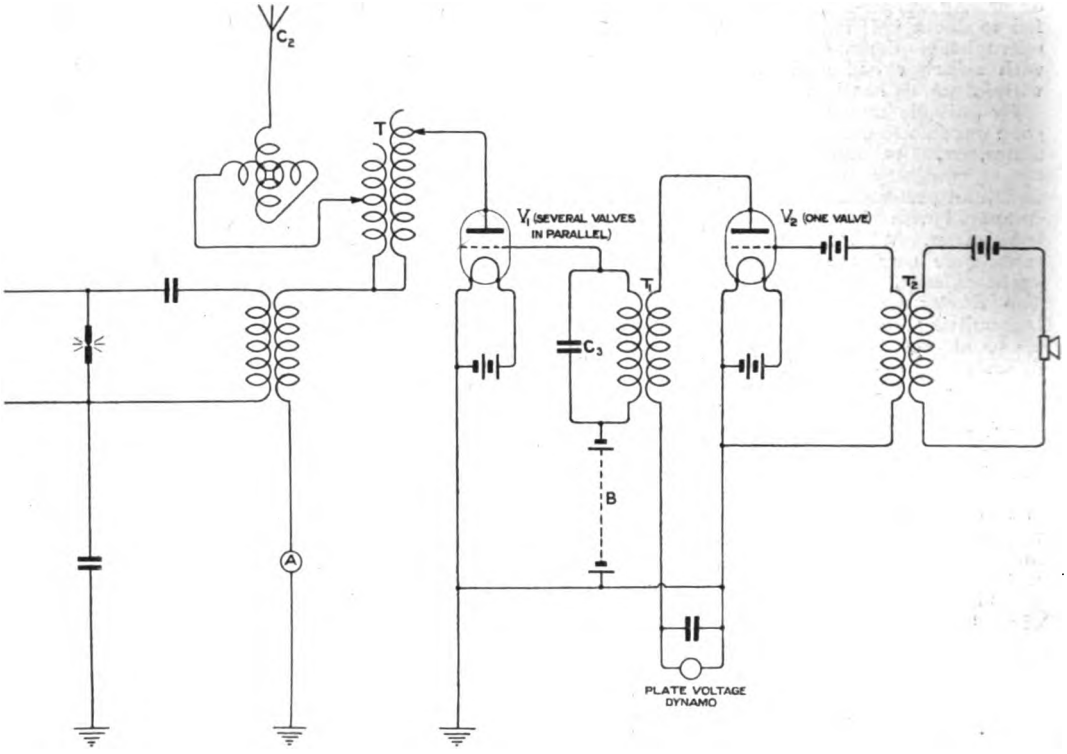


*Fig. 5.*

can easily be noticed by emitting a constant musical note in front of the microphone. The negative voltage of the grid may be regulated either by the insertion of a steady e.m.f. of suitable value in the grid circuit, or by regulating the value of the capacity $C_3$ (Fig. 5). The action of the condenser $C_3$ can readily be seen by noting that through the effect of the unilateral conductivity of the valve it becomes charged to a potential which depends on the value of its capacity and the time constant of the circuit shunted across it—which in this case is the primary of the transformer $T_1$.

**6.** It is at once seen that when working at the point of the modulation characteristic marked with an X in Fig. 6, the modulated oscillations become unsymmetrical, the increments of current being much less than the diminutions.

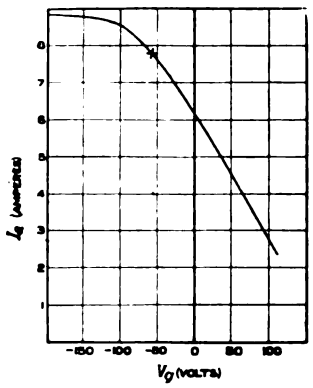


*Fig. 6.*

By way of confirmation, oscillograph tests were carried out, using a Gehrcke's tube and a revolving mirror. The tube was connected between the antenna and the earth through a suitable high resistance or a small capacity. In the first place it was ascertained that the tube gave indications approximately proportional to the antenna current. In Fig. 7 are reproduced three photographs of the oscillograph line traced out with three values of the antenna current, from which it is evident that the proportionality is approximately satisfied.

If we examine the oscillograph tube with a rotating mirror we obtain oscillograms such, for example, as the one reproduced in Fig. 8, which corresponds to the continuous emission of the vowel "O" before the microphone. Fig. 9 shows the cathode illumination of the tube spread out by means of a mirror, under the same conditions as in the preceding experiment, only in the absence of sounds in front of the microphone.

It is easily seen that the increase of amplitude of the oscillations under the influence of the voice is very small, though perceptible and distinct, but that the diminution reaches as far as the dark part of the tube.

The conditions during the experiments were as follows:—

Antenna current with modulating valve out . . . . . 15A

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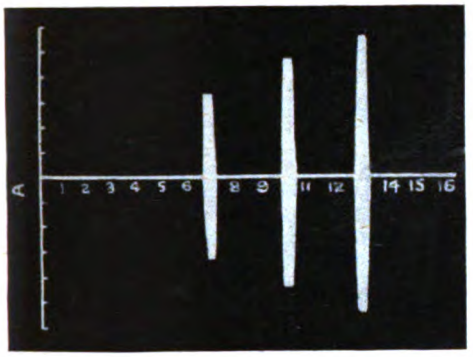


*Fig.* 7.

Antenna current with modulating valve alight - - - - - - - - 14A
Antenna current during the continuous emission of the vowel sound "O" - 9A

The increase in the modulation cannot therefore exceed one ampere in fourteen, that is 15 per cent., while the diminution is very much greater.

Another oscillogram (Fig. 10) was obtained by adjusting the apparatus so as to obtain a more regular modulation, both by producing a greater initial diminution of the current and by thus obtaining more symmetrical variations of antenna current. The intensity of the signals was inferior to that obtained with unsymmetrical modulation,

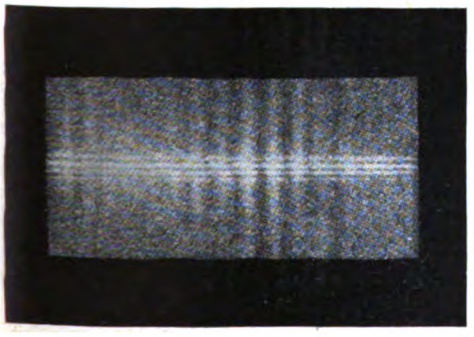

*Fig.* 8.

while there is also the added disadvantage of greater danger to the absorbing valves due to the greater energy dissipation in them. No perceptible increase in clearness was observed.

**7.** At first sight it would seem that the unsymmetrical modulation produced near the bend of the modulation characteristic would constitute an unfavourable control, and that considerable distortion in the voice would be produced.

In practice this effect was not noted, and the voice always came out clear and without defect, so that one could at once recognise who was speaking or singing in front of the microphone.

As regards this point, some experiments were also made on a wire telephone circuit, and an attempt was made to reproduce the condition that obtains in radiotelephonic transmission with unsymmetrical modulation. The arrangement shown in Fig. 11 was used for this purpose. By means of the battery B, it was possible to give to the grid positive or negative voltages, and therefore to vary the working point of the valve characteristic. The continuous current milliammeter A gave indications of the line current.

It was clearly proved that the articulation always remained good for all the points comprised between A and B (Fig. 12) though a certain improvement in the timbre was observed about the middle point C. At this last adjustment the milliam-

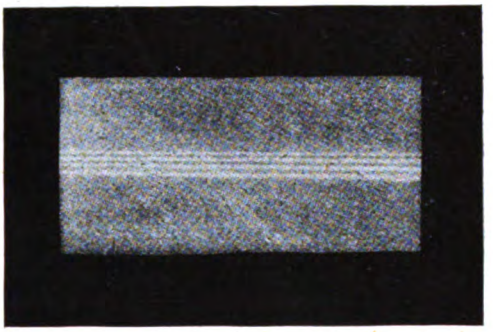

*Fig.* 9.

meter A (Fig. 11) in the line did not show any perceptible variations during modulation, while at the points A and B there was respectively a distinct increase and a distinct decrease of the current on account of the dissymmetry of the line telephone current. Only by going a long way beyond the points A and B did one notice a marked distortion of the voice. Taken together then, these tests enabled it to be established that in order not to overload the absorption valves it is permissible to use a markedly unsymmetrical modulation in the scheme here described, with no detriment to the clearness and quality of the transmission.

It is apposite, too, to observe that in radiotelephonic reception, when employing a crystal detector or a non-oscillating triode valve, there is a tendency to introduce additional dissymmetry at the receiver, in that the increases of current are magnified in comparison with the diminutions. By allowing the modulation to take place at the point indicated on the characteristic in Fig. 6

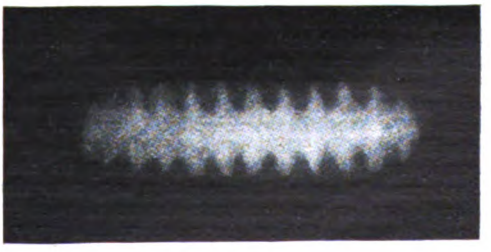

*Fig.* 10.



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there is therefore a certain compensation between the two distortions produced respectively at the transmitter and at the receiver.

**8.** The results obtained by applying the above described methods to the arc radio transmitting station at Centocelle (Rome) were truly remarkable. With an antenna current of 14

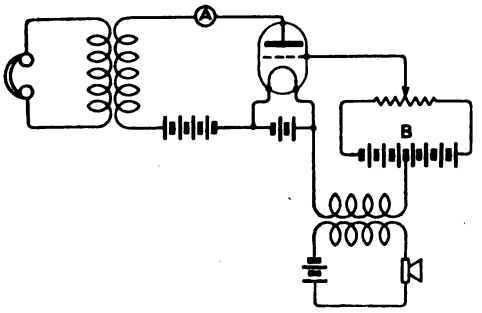


*Fig.* 11.

amperes modulated in the above very unsymmetrical manner, the voice was intensely clear and strong over distances up to more than 1,800 km.

The data relative to the aerial used in these tests is as follows:—

| | |
|---|---|
| Natural wavelength - - | 1,890 m |
| Length of wave emitted - - | 2,700 m |
| Static capacity of the aerial - | $8{\cdot}26 \times 10^{-3} \mu F$ |
| Effective height - - - | 40·3 m |
| Effective resistance - - | 7·3 ohms |
| Antenna power - - - | 1·46 kW |

The signals were received exceedingly well over the above-mentioned distance with a three-valve receiver, one of the valves being for rectifying, the other two low frequency amplifying valves used on a naval type of aerial. Stronger signals were obtained by using 7-valve high-frequency amplifiers of the Marconi type 55D and 8-valve French amplifiers, having five high-frequency valves, one rectifying valve, and two low frequency amplifying valves. At distances of the order of 500 km with a ground aerial of modest dimensions, the radiotelephonic signals were received loudly and perfectly even with an ordinary crystal receiver, and it was even possible to insert the radiotelephone receiver in an ordinary telephone circuit.

**9.** Extensive experiments were then made in order to ascertain whether the system of modulation employed deformated the carrier wave in such a way as would cause abnormal interference, or give rise to harmonics of excessive amplitude. For these tests, there was a choice of two receiving stations, one about 5·68 km and the other about 27·4 km distant from the transmitter. The first of these stations was provided with a large T-shaped aerial, a Navy type of receiver was used with two valves, one rectifying and the other amplifying. In this receiver the grid of the rectifying valve is connected directly to the inductance of the aerial, thus giving easy reception of signals and only a moderate degree of selectivity. In the second station, provided with a very low and directive aerial, several types of amplifiers were used in a secondary circuit loosely coupled to the aerial.

It was observed, as was to be expected, that the tuning of the radiotelephonic transmissions was

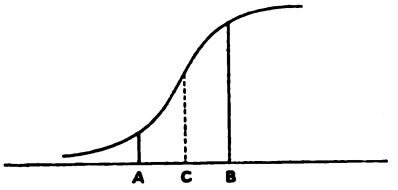


*Fig.* 12.

a little less sharp ($\lambda$ = 2,500 m) than that of the continuous non-modulated wave, but no trace of harmonics or abnormal disturbances was found.

In one particular instance, by allowing another continuous-wave station to transmit at the same time as the radiotelephone at Centocelle it was possible to pick up in a receiving station situated about 24 km from the two above-mentioned stations, either of the two transmissions without interference, although the difference of wavelength could not have been as much as 4 per cent.

The continuous wave station used a much lower voltage than the radiotelephone transmitter. As a matter of fact, the product of the radiation height of the aerial expressed in metres and the effective value of the antenna current expressed in amperes was 521·6 for the station at Centocelle, while the same product for the continuous wave station was only 188. It was distinctly noticed that the disturbance produced by the voice was smaller than that produced by the "rustling" noises of the arc. The disturbance was also much reduced by virtue of the inductive coupling adopted.

**10.** It thus results that the Poulsen arc used with inductive coupling in conjunction with a good system of modulation lends itself admirably to the purposes of radiotelephony, and enables distinct and loud communication to be effected over a considerable distance. The disturbing noises are greatly reduced in the arrangement described, and do not prejudice in any way the quality of the radiotelephonic signals.

The apparatus in use at Centocelle was constructed with material at hand by the Chief Torpedo Constructor and the experiments were conducted by the chief officer of the station.

## Commercial Wireless Conference

The Commercial Radio International Committee composed of the representatives of the Radio Corporation of America, Compagnie Générale de Télégraphie sans Fil, Gesellschaft für Drahtlose Telegraphie m.b.H. and Marconi's Wireless Telegraph Co., Ltd., has completed its Conference held at Cannes under the Presidency of Senatore Marconi.

As a result of agreement between the four Companies, a number of new international wireless telegraph services will be opened in the early future. A very considerable development of communications generally has been discussed and agreed upon.

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# Wired Wireless*

By E. Mallett, M.Sc., Assist. Prof. City and Guilds (Eng.) College.

## (1) Introduction.

THE title "Wired Wireless" is the popular term that has come to be applied to the system of multiplex telephony and telegraphy which employs high frequency currents. It is sometimes referred to also as "Carrier Wave Telephony," but this is hardly a correct description, as will be evident from the fact that in the latest practice the "Carrier Wave" is not propagated through the line at all.

"High Frequency" telephony was first achieved by G. O. Squire in 1911, using a H.F. alternator and working in one direction only over a telephone line which at the same time carried ordinary telephone traffic. He recognised the possibilities of the system for multiplex telephony, and took out master patents. It was not, however, until the advent of the three-electrode valve as a generator of H.F. current that any progress towards a practical realisation of the scheme was made, and "Wired Wireless" is one of the many branches of communication engineering that has been revolutionised by the pioneer efforts of J. J. Thomson and Richardson, and others on the side of the physicists, and Fleming and Lee De Forest on the engineering side, in their work on electrons, thermal emission of electrons and valves.

In the actual problems of making a practicable multiplex telephone circuit, the honours seem to be divided between America and Germany. In America the research staffs of the W. E. Co., and the A.T. and T. Co., led by Colpitts and Blackwell, and in Germany K.W. Wagner, have been responsible for elucidating the many problems and overcoming the many difficulties that arose.

## (2) Main Aspects of the Problem.

The original idea was simple. The æther waves of Wireless Telephony were simply to be guided by wires. Tuned circuits for transmission and reception were to be used, and so these various channels, employing different "wavelengths," would be received each on its tuned circuit.

*(a) Line.*

The idea was held and persisted for a long time, that in some mysterious way the losses normally associated with telephone transmission would not occur; the energy would be propagated through the æther—which is true—and that in consequence there would be no losses or only small losses in the line, which would merely guide the energy propagation. The theory as to no losses was quite untrue. H.F. waves in wires follow exactly the same laws as telephone waves; the only difference is that owing to their higher frequency the losses are much greater.

The first attempts in this country were made with an Air Force telephone set working on about 600 metres (frequency 500,000). The wireless transmitter was inserted in the aerial line through a loosely coupled coil, and the receiver was taken to a point about five miles away. Good speech was received and the length was extended up to about twenty miles, but that was the limit. That was at the time when the "no loss" theory held. Actually, of course, owing to the H.F. resistance and increased leakance at the frequency employed, the losses were so great as to limit the range to twenty miles. Better results would probably have been obtained without the wires.

When these H.F. losses became realised the frequency was very much lowered, but this introduced a further problem.

*(b) Modulation.*

Wireless telephony is achieved by altering the amplitude of the H.F. wave in accordance with the speech wave at the transmitting end, and at the receiving end the wave is rectified so that its varying amplitude is reproduced as a speech wave.

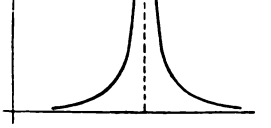

*Fig.* 1.

Thus, if $Q/2\pi$ is the frequency of the "Carrier Wave" and $P/2\pi$ that of one of the constituent waves of the complicated speech wave, then for the carrier wave at any instant we may write—

$$i = A \sin Qt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and for the modulated amplitude $A$—

$$A = a(1 + k \sin P t) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where $a$ and $k$ are constants and $k$ is less than unity and depends upon the completeness of the modulation; and $a$ is the unmodulated amplitude.

Combining (1) and (2) we have—

$$\begin{aligned} i &= a(1 + k \sin P t)(\sin Q t) \\ &= a \sin Q t + k (\sin Pt \sin Qt) \\ &= a \sin Qt - ak/2 \cos (Q + P) t + ak/2 \\ &\qquad \cos (Q - P) t \quad . \quad . \quad . \quad . \quad . \quad (3) \end{aligned}$$

So that for every telephone frequency $P/2\pi$ we have introduced two frequencies $(Q + P)/2\pi$ and $(Q - P)/2\pi$, and in order that there may be no distortion all of these must be propagated with equal attenuation and be equally dealt with by the receiving apparatus. $P/2\pi$ comprises all frequencies say between 200 and 2,000 per second; so that the speech modulated wave is equivalent to a complicated wave having a band of frequencies on each side of the carrier frequency.

Now at the high frequencies used in Wireless Telegraphy, say 500,000 ± 2,000 is a small quantity, and the whole band will be very little distorted by the receiving aerial.

* A Presidential Address read before the City and Guilds Wireless Society on February 8th, 1922.



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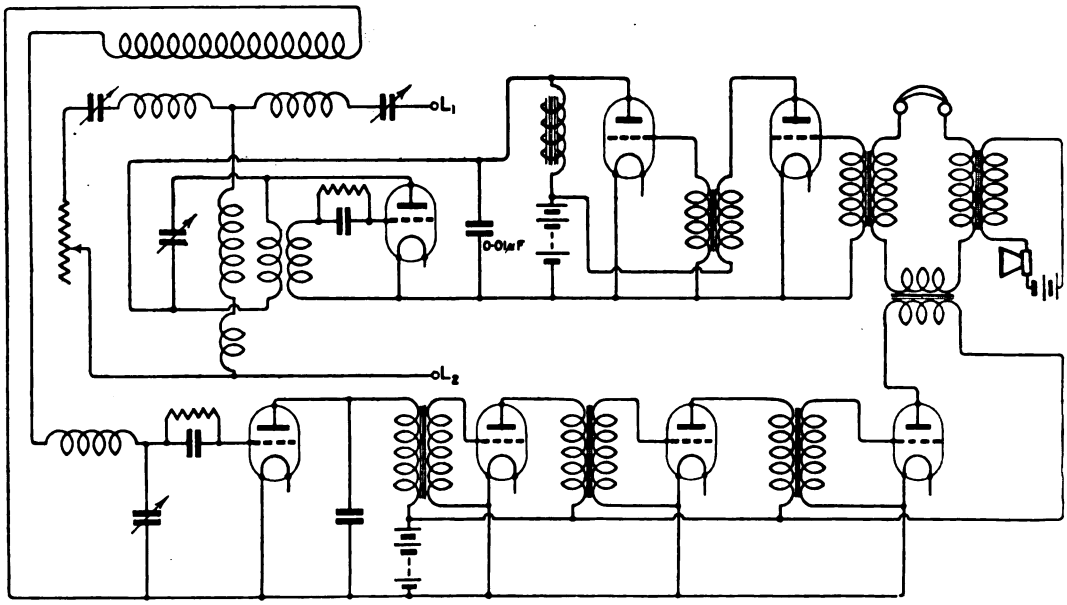


*Fig.* 2.

But if we employ a carrier wave of 10,000, we shall have all frequencies from 8,000 to 12,000 and the resonance curve, if sharp (as in Fig. 1), will cause very unequal treatment and consequent distortion.

Hence, sharp tuning is impossible, and recourse has to be made to "filters" to separate the various channels, since we must employ the lower frequencies to avoid very high attenuation.

(*c*) *Both way working.*

All telephone systems must be capable of being worked in either direction without switching. This can be achieved in Wired Wireless by using a different carrier frequency in each direction, or by using the same frequency and a bridge. The latter is much the more difficult method, but allows more channels.

**(3) First Circuit in this Country.**

The diagram (Fig. 2) shows the first circuit that was set up in this country, nearly two years ago now, from London to Bristol. Although different carriers were used in each direction, it was found necessary to use a bridge arrangement in addition, as no filters were used.

This circuit was set up before the publication of the American and German articles, and represents the very little that we in the Post Office were able to achieve independently. The circuit is working to-day.

**(4) The "Wireless" Problems.**

(*a*) *Filters.*

Much has been written recently about filters, and the design of suitable filters is a great problem that has been solved with apparent success by K. W. Wagner.

The filter must pass a band of frequencies from $Q/2\pi$ to $\pm P/2\pi$, where $P/2\pi = 2{,}000$.

Of the two bands ($Q/2\pi + P/2\pi$), and ($Q/2\pi - P/2\pi$), it can be shown that one may be suppressed without serious distortion, so that our filters must then pass a band of frequencies 2,000 per second wide with very small attenuation, and offer a large attenuation to all frequencies

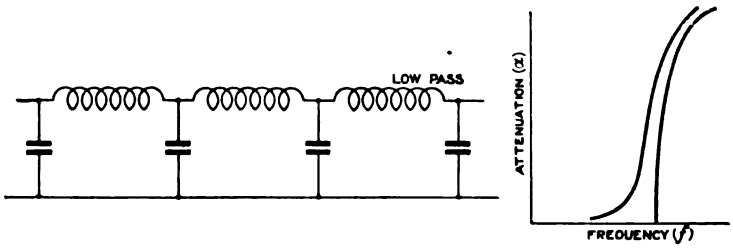


*Fig.* 3. *Campbell's Filter.*

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outside this range. Also, the carrier frequency itself can be suppressed if it is supplied again—on the heterodyne principle—by an independent oscillator at the receiving end.

be reflection unless the chain impedance is the same as the line impedance.

So the ideal to be aimed at is to make the two characteristic impedances the same.

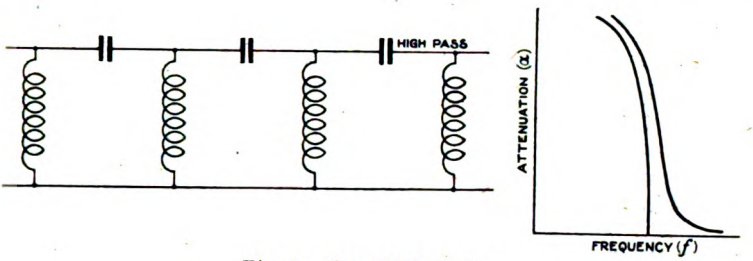


*Fig. 4. Campbell's Filter.*

Fig. 3 shows a filter chain (due to Campbell) which will pass low frequency currents, and Fig. 4 one that will pass high frequency currents.

So that two such chains in series will give the required characteristic (Fig. 5).

A neater way is due to K. W. Wagner.

This gives a curve similar to the above, and the band can be made the correct width and the actual frequencies desired by suitable choice of the inductances and capacities.

Another chain used in America and also giving a band characteristic is shown in Fig. 6.

*(b) Modulation and Rectification or Demodulation.*

The method usually employed for modulation is shown in the previous diagram (Fig. 2). It depends on working the oscillator so that the amplitude of the oscillations is limited by the anode potential, and then modifying this anode potential by means of the speech wave as in Fig. 10.

The Americans in their wired wireless schemes use a different method (Fig. 9). In this country we have developed a valve with a straight characteristic. The coated filament valve of the Americans gives a curved characteristic—$I = \alpha(V + \mu E)^2$ very nearly.

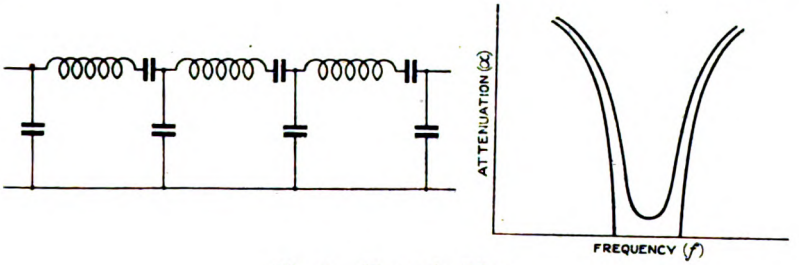


*Fig. 5. Wagner's Filter.*

The theory of these filters has been very completely given by K. W. Wagner in *Archiv für Elektrotechnik*, Vol. (3), 1915.

He shows that with a chain as in Fig. 7. where R and G may be complexes representing impedances of any sort, the total attenuation is given by the real part of $n\gamma$ where $n$ is the number of links and $\gamma = \alpha + j\beta =$ the propagation constant per link.

$$\text{Sinh } \tfrac{1}{2}\gamma = \tfrac{1}{2}\sqrt{RG}$$

and the characteristic impedance is given by

$$W = R/2 \tanh \tfrac{1}{2}\gamma$$

If the chain is arranged as in Fig. 8. the attenuation is the same, but the characteristic impedance is :—

$$W = 2 \tanh \tfrac{1}{2}\gamma/G$$

These are the impedances for infinite chains. If the chain is not infinite we have all the complicated expressions that are obtained in telephone line problems owing to reflections.

When the chain is joined to a line there will

So that if the carrier wave and the speech wave are impressed simultaneously in the grid, the carrier wave is modulated because of the curved characteristic.

A development is the "balanced modulator" which suppresses the carrier wave while passing the side bands. One side band is then cut off by the filter (Fig. 11).

Current only flows to line when the speech currents are present.

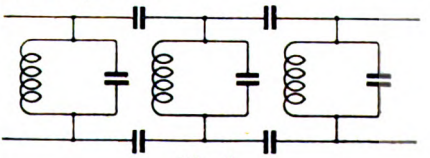

*Fig. 6.*

**Harmonic Generator.**

The various channels have carrier waves which are multiples of a fundamental, say, 5,000. In this

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way Difference Waves within the speech range are avoided. The main oscillator produces an oscillation of frequency 5,000. This is amplified by another triode, which is overloaded and so produces harmonics. The harmonics are led through suitable circuits, where they are amplified and supply

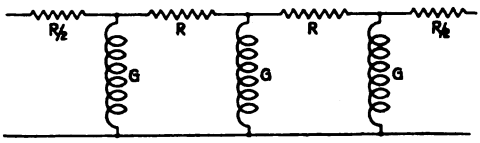


*Fig.* 7.

the carrier wave. The fundamental is transmitted through the line and at the far station an amplifier in a similar manner supplies the carrier waves which are necessary but have not been transmitted.

The *rectifier* or demodulator also depends upon the curved characteristic of the valve.

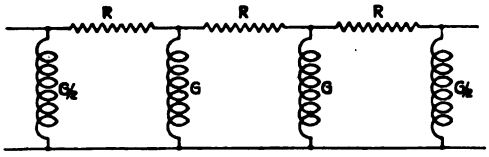


*Fig.* 8.

It follows from the previous analysis that on the output side of the rectifier we shall have sum and difference waves. The difference are the speech frequency waves that we want, and their amplitude is proportional to the product of the amplitudes of the speech wave, and the carrier wave. Hence that of the latter must be made large, as it can with the locally amplified carrier wave that is used, for efficient working. Another reason for making the carrier wave amplitude large is that there will be present sum and difference waves of the speech

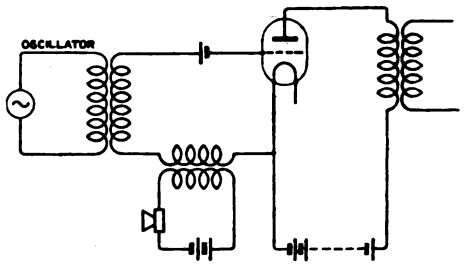


*Fig.* 9.

**(5) The Wire Problems.**

In an infinitely long perfectly uinform line, the attenuation is given in the real part $\alpha$ of the expression :—

$$\sqrt{(R + j\omega L)\ (G + j\omega C)}$$

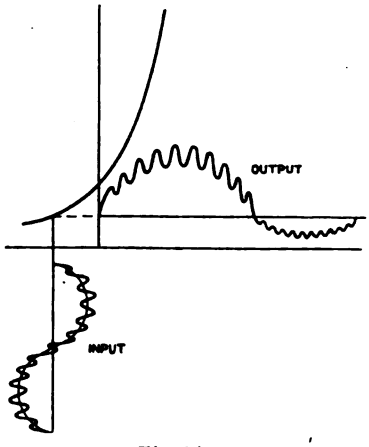


*Fig.* 10.

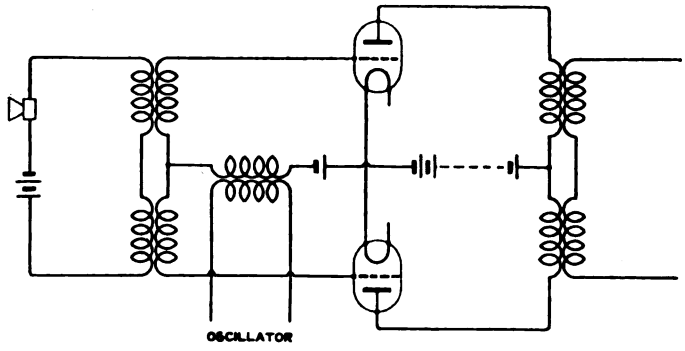


*Fig.* 11.

waves $P_1$ $P_2$ $P_3$. These will seriously distort speech unless their amplitudes are small compared with the desired waves, and this they will only be if the products $(k_1\ k_2)$ $(k_1\ k_3)$, etc., are small compared with $ak_1$ $ak_2$ $ak_3$, etc.

The speech wave is amplified after rectification.

$L$ and $C$ are practically the same as at low frequencies, but $R$ is increased by the skin effect and $G$ also is increased with frequency.

A typical attenuation frequency curve would be as shown in Fig. 12.

The impedance of the line is of great importance

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as it must be balanced for repeaters to be used. This is given in an infinite uniform line by $\sqrt{R + j\omega L/G + j\omega C} = \sqrt{L/C}$ at the higher frequencies. Thus it could be balanced by a pure resistance.

Actually, however, when the impedance of the

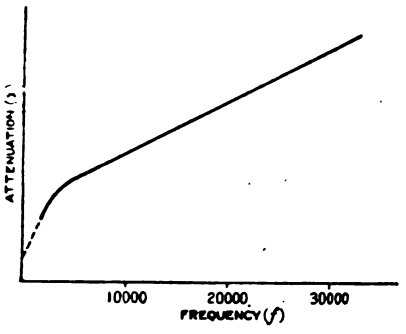


*Fig.* 12.

line is measured for various frequencies, one usually finds marked humps, caused by reflections from some impedance discontinuity, such as a length of underground cable through a town or across a river.

These must be got rid of as far as possible by suitably loading the cable length or inserting autotransformers at the beginning and end.

Where more than one pair on the same pole route is used for Wired Wireless, troubles from "cross talk" arise. The balancing transpositions for cross talk, which suffice for ordinary telephony are quite inadequate for the higher frequencies of Wired Wireless, and the transpositions must be much more frequent.

The repeaters used are inserted more frequently than the repeaters of ordinary telephony, but in general follow the same lines. To avoid the modulation that would normally occur when all the various frequencies are passed through the one valve, an arrangement of two valves is employed in what the Americans call the "push-pull" scheme. It is similar to that employed to suppress the carrier wave.

The above is only intended as an introductory outline to a large and interesting subject. Fuller details may be found in—

(1) **E. H. Colpitts and C. B. Blackwell** "Carrier Current Telephony and Telegraphy," A.M.I.E.E. (*Journal of the American Institute of Electrical Engineers*, 40, pp. 301-315, April; pp. 410-421, May; and pp. 517-526, June, 1921).

(2) **K. W. Wagner.** Electrotech. Zeitschrift Nos. 32 and 33, 1919 (Wired Wireless).

(3) **K. W. Wagner** (*Archiv für Elektrotechnik* 3, 1915). (Filters.)

# The Romance of Wireless Calls

By *Laurence le Brun.*

YOU may ask a hundred wireless men a simple question about wireless calls, and probably not one of them will be able to give you a definite answer. Just ask, "Why is the distinguishing call for Fishguard Wireless Station **GRL**?"

Yet there is a reason, and a little romance is attached to it. Twenty years ago five coast stations were opened in England and Ireland for communication with ships at sea: Crookhaven, co Cork; Rosslare, co. Wexford; Holyhead; Caister, near Yarmouth, and North Foreland. And they were each given call-letters, which told the listener the stations' names. Thus: Crookhaven became **GCK**; Rosslare, **GRL**; Caister, **GCS**, and North Foreland, **GNF**. These abbreviations were very useful at that time; the "G" gave the nationality and the two other letters were taken from the name of the locality of the station. Later, the Rosslare station was dismantled and erected at Fishguard, South Wales, and even to-day, hanging on the dusty file which covers the long-forgotten records of great distances and primitive administration, may be seen typewritten orders bearing the heading "Rosslare Wireless Station."

The pioneer wireless stations in Great Britain were originally allotted "calls," which followed a preconceived plan and told at a glance the name of the station. Poldhu, beloved of the pre-war "listener-in," but to-day almost forgotten and sadly neglected for the greater glories of Annapolis and Long Island, was familiar to all as **MPD**, a call she (wireless stations are human and very feminine) retains even now. In this case, the letter "M" was used to denote "Marconi," the other two, of course, being merely the usual abbreviation of the station's name.

Cookhaven, the station mentioned above as being one of the pioneer British stations, is very silent nowadays. Sometimes, perhaps, if you can get down to 300 metres, on a very good night you may hear Crookhaven. But you will not hear **GCK**. Crookhaven no longer holds her own original call, for an upstart has claimed it and poor old Crookhaven has had **GXO** flung at her, whilst Valentia (the first short wave station the trans-atlantic operator hears as he nears Ireland) flings the time-honoured "call" halfway across the Atlantic. Crookhaven is one of those little low-power stations which did such good work twenty years ago. But wireless has progressed, and low, croaky notes like Crookhaven used to emit have given place to blatant, musical ones. Hence, Crookhaven has had to get off 600 metres altogether, and the five-kilowatt-proud Valentia has taken her place and call. To add insult to injury, in exchange, the authorities who do these things have given her a call-sign **GXO**, which conveys nothing of her past glories and vaguely reminds one of beef-extract.

Only a comparatively small number of calls telling at first glance the name of the ship or station now remain. In the beginning, the ships and stations of Great Britain were distinguished by their calls commencing with one of the letters G, M, or B. Those using the latter letter as initial

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were in the first place naval ships and stations. For instance, **BYA** still remains the Admiralty's call, whilst **BYB** and **BYC** (Cleethorpes and Horsea) are quite familiar to every man who dons the telephones with a knowledge of the Morse Code.

It soon became evident that all ships fitted with wireless in the British Mercantile Marine could not be accommodated under three letters commencing with "G" and "M," and eventually the ships of the Navy, having private call-letters as well, discarded their Berne calls. As time went on, other letters were allotted and various combinations constructed. **GNF** is still North Foreland; **GLV**, Liverpool (Seaforth); **GNI**, Niton (I.O.W.); **GMH**, Malin Head; **GLD**, Land's Head; **GCC**, Cullercoats; **GNV**, Newhaven, and **MPD**, Poldhu. Ship stations retain more of the old romantic calls, as **MAA**, "Carmania"; **MRA**, "Caronia"; **MPA**, "Carpathia"; **MDC**, "Cedric"; **MLC**, "Celtic"; **MCL**, "Colonia"; **MCN**, "Corsican"; **MPB**, "Empress of Britain"; **MPJ**, "Empress of Japan"; **MRN**, "Grampian"; **MGN**, "Virginian"; **MSA**, "Saxonia"; **MDN**, "Scandinavian"; **MNN**, "Numidian"; **MTN**, "Tunisian," and perhaps a few others that I have overlooked.

Abroad, the custom of making the "call" similar to the name of the station continues, and in order to do this we find many foreign stations encroaching upon the preserves of other countries. Moscow poaches an "M" from Britain's conservation and says "I am **MSK.**" According to my list of call-letters, **MSK** belongs to a British ship one "City of Vienna," and Moscow has no right at all to use it. Constantinople (Osmanie) appropriates one of Belgium's "**O's**" and disturbs the region of 7,000 metres as **OSM.** Again, the Polish station at Posen until recently used one of Portugal's legal calls and boomed across the North Sea as **PSO.** Now, however, Berne has decided to make all countries toe the line and use only their allotted call-signs. Hence, Posen is familiar to us all as **AXJ.** Petrograd, on 1,600 metres, is really infringing the International Regulations by using **PTG** as a call; this actually belongs to Brazil, whilst the famous Nauen station, **POZ,** has another "appropriated" call belonging rightly, as in the case of Petrograd, to Brazil.

Other countries also have their "romantic" calls. Ostend could not be better designated than by **OST,** and she is quite justified in using it because Belgium's Berne-allotted calls include all those between **ONA** and **OTZ. PRG,** Prague, is one of the most striking abbreviations in daily use, whilst **BUC,** Bucharest, is another case in which Britain's conservation has been encroached upon.

The tell-tale type of call is, however, rapidly dying out. So great has become the number of ships fitted with wireless that three-letter call-signs will not be sufficient. To-day Britain has as initial distinguishing letters B's, C's, E's, G's, L's, M's, O's, X's, Y's and Z's, besides a whole list of four-letter calls beginning with the letter "G." America, too, has used up all her three-letter calls, and has quite a formidable list of four-letter ones.

If an operator in a ship with a name something like "War Weezlewood," and a call-sign possibly like **GXYZ,** reads this article, I hope he will forgive me. For there is no call-sign romance for him; I can imagine nothing worse than having a call-sign like that.

## An Experimental Station in Yorkshire

THE accompanying photograph shows an experimental station, and is of particular interest as it gives a good method of arrangement. All of the instruments have assumed fixed positions and the wiring up, though accessible, is hidden away, which adds much to the general appearance and facilitates manipulation. It may be argued that the disposition of the instruments

does not lend itself to experimenting, but the advantage of always being able to find a station by recorded adjustments is a distinct feature in these days of interesting telephony transmissions. Moreover, experimental work can be conducted with auxiliary gear, and when a definite improvement is found, it can, after careful trial, be incorporated in the station.

This set consists of a six-valve French amplifier, L1, 1917. The tuner is a Marconi M 12. To the left of the photograph is seen a smaller set which consists of a Mk. I** single valve receiver and transmitter. With this set a C Mk. III amplifier is used, and works very satisfactorily, giving a tuning range of from 80-1,600 metres. The aerial is a twin-wire 70 feet long, and 42 feet high.

The glass case above contains the switches and metres, as well as the aerial and earth switch.

Both signal and telephony are very clear on French amplifier. Croydon and Pulham also the Dutch concert have been heard. Local stations, **2AW, 2KD, 2JP, 2IQ, 2GU** and **2QK** come in very clear and loud, and can be heard with the telephones laid on the table. Ships and other 600 metres stations are received well. W. GILL.

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# Progressive Amplifier Design*

By W. J. JOUGHIN.

IN this paper it is my endeavour to give a description of the difficulties encountered, and how they were overcome, in an endeavour to build an efficient amplifier.

Having obtained an early pattern de Forest Audion valve, I built it up into a detector panel, using the tuning coils of an early crystal receiver as aerial inductance and reactance. This pattern valve has a grid on each side of the filament, and also a square plate similarly placed.

Being a soft valve it gave much trouble in initial adjustment, and since my knowledge at that time was practically nil, I had to experiment, as it were, in the dark. The circuit was quite normal as can be seen by Fig. 1, using a potentiometer for adjusting the grid potential. Having tried every possible variation in arrangement of coils and L.T. battery, I was unable to produce the least sign of a signal until I made what I then thought was a mistake. Having switched on the filament, I omitted connecting one side of the potentiometer to the filament battery, and immediately heard quite good signals. By substituting a grid condenser, I dispensed with the potentiometer. This type of valve I found extremely sensitive, and after having been accustomed to crystal detectors was a revelation in signal strength. In common with all soft valves, the value of high tension required is extremely critical, the one in question requiring 40-45 volts. I also experienced the unstable working due to the comparatively large quantity of residual gas.

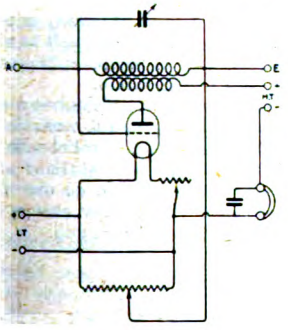


*Fig.* 1.

Having gained some experience, I then built up a two-valve receiver using an aerial coil of 4½ ins. diameter, 10 ins. long, wound with 26 gauge enamelled wire. The reaction coil was 8 ins. long and 4 ins. in diameter wound with 30-gauge S.C.C. wire, and fixed right inside the aerial coil. Since this was so tight I had to take off several tappings. The amplifier arrangement is shown in Fig. 2, the only item to comment on being a condenser between the intervalve transformer secondary and grid of No. 2 valve, which I found made a slight increase in signal strength. This condenser caused a temporary wipe out of signals when a strong X came along, and by the addition of a grid leak I cured the trouble and lost the advantage previously gained. Since the wipe out effect was not very troublesome, I left the condenser in as shown. In operating the set I had as much reaction in as possible. It can be imagined to what extent I was oscillating, since I usually worked just short of the howling point. Fortunately, I was about twenty miles from any other station, so that there were no pertinent questions asked. It should be noted, however, that the signal strength was quite good, especially just short of the howling point of L.F. oscillations.

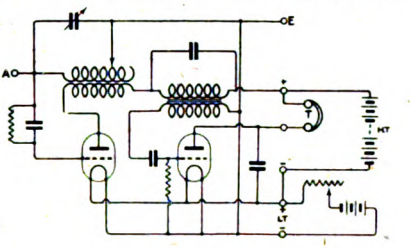


*Fig.* 2.

The next venture was, as I subsequently learnt, an impedance amplifier. The lines I worked on, were to see if it were possible to make an amplifier where the variations in plate current could be transferred direct to the next grid. Since the high tension must be kept from the grid, it was necessary to insert a small condenser and then devise some means by which the high tension could reach the plate without the signals leaking away through the same path. This was easily accomplished between the second and third valves (Fig. 3) by using the secondary of an intervalve transformer. When the set was working, I put a pair of telephones across the idle transformer primary and could not hear the strongest of signals, thus showing that I had attained my object.

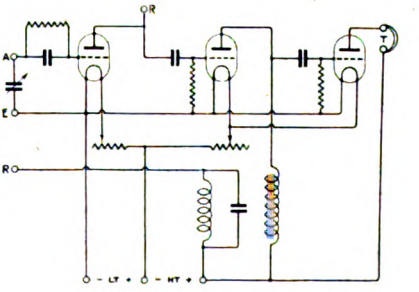


*Fig.* 3.

* Paper read before the North London Wireless Association.

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This effect was what I had set out to obtain, and by using a still higher impedance I was able to increase the signal effect. But turning to the coupling between the first and second valves, I was in a quandary, since my impedance must allow the high frequency component from the reactance to pass, and also the high tension supply, but yet hold back the low frequency signals. For some time I used an inductive air core resistance with a small condenser in parallel. The condenser was sufficient to bypass the H.F. oscillations, the the resistance to pass the high tension, and but to a small extent to retard the signals.

I found it essential, however, to replace this most inefficient arrangement by an intervalve transformer which was but a compromise on what I had originally set out to make.

With the experience gained, together with quite protracted study on the theoretical side of the question, I evolved the following low frequency amplifier of quite normal wiring, but carefully studied accessibility of controls. From Fig. 4 it can be seen that there is a small variable capacity across the reactance, which, in spite of statements made by good authorities to the contrary, is found

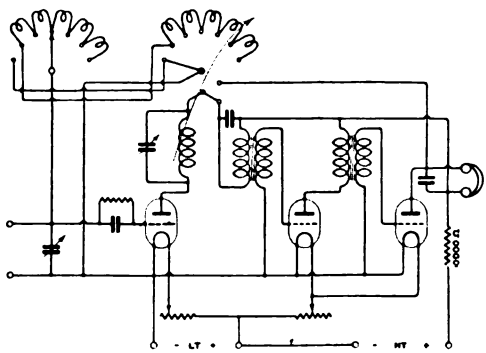


*Fig.* 4

to be very useful for efficient telephony reception. Those who have tried it will certainly agree that no tuner is complete without it. It will be noticed that the aerial and earth are connected direct to the two switch arms, one switch being for the 400-1,200 metre coil, and the other to the 900-5,000 metre coil. The beginning of each coil is connected to the first stud on other switch. This is a method of using just an extra stud on each switch as a change over from one inductance to the other, and entirely cutting out the one not in use. When using coil No. 1, the switch of No. 2 is put on the first stud. The circuit is then from the aerial terminal to switch arm No. 1, through the amount of inductance being used, to switch arm No. 2, *via* the first stud, and, of course, the same applies when using inductance No. 2 by putting switch No. 1 to the first stud.

For using one or three valves, the plate of the rectifying valve goes to a two-way switch. For single-valve working it connects direct to the plate of No. 3 valve (*i.e.*, telephones) and for three-valve working, it connects to the first intervalve transformer primary. For telephony it may be found better to use a low value grid leak, say ·5 megohms, since the question of grid leak values is so contradictory, I just put forward my suggestion as ground for experiment. Two filament resistances are used, since it is advisable to have full control over the rectifying valve.

To save the danger of shorting the high tension battery when experimenting, it is advisable to put a resistance in the positive lead, of suitable value to the voltage being used. For 100 volts, a resistance of 10,000 ohms non-inductive, is quite suitable.

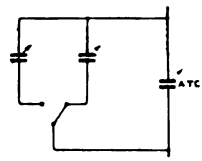


*Fig.* 5.

Only one reaction coil is used, a pancake coil mounted so that it can be coupled to either of the two inductances, and is found sufficient and quite efficient over the whole range.

Another useful item for telephony reception is the arrangement of two small variable condensers with a two-way switch, in parallel with the tuning condenser (Fig. 5). If two stations are in communication, each is tuned to on one of the small condensers so that when they change over, it is only necessary to move the switch.

## Hourly Weather Messages on Civil Air Routes

THE hourly meteorological reports for aviation issued by W/T from the Air Ministry are being sent in the revised code forms adopted by the International Commissions for Weather Telegraphy and for the Application of Meteorology to Aerial Navigation at the meetings held in London in September, 1921. While the new code forms differ from the one formerly in use, the specifications of the code figures remain practically unchanged, the only important alterations being found in the specifications and of speed of low cloud.

Reports are issued daily, Sundays included, according to the following schedule :—

Wavelength.—1680 m.

Nature of transmission.—Continuous Wave.

Call sign.—GFA.

| Times of issue. G.M.T. | Times of observations. G.M.T. |
|---|---|
| 0735 | 0700 |
| 0835 | 0800 |
| 0935 | 0900 |
| 1035 | 1000 |
| 1135 | 1100 |
| 1235 | 1200 |
| 1335 | 1300 |
| 1435 | 1400 |
| 1535 | 1500 |
| 1635 | 1600 |

After the call sign GFA, comes the word

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"METEOR," indicating that a meteorological message is being transmitted. This is followed by one 4-figure group giving the hour (G.M.T.) at which the observations were made. The time group is followed by a series of figure-groups indicating the stations and the meteorological conditions thereat. The group giving the index number of the station consists of 2 figures (3 figures in the case of a station reporting sea visibility); this group is followed by groups of 5 figures giving the meteorological conditions at the stations. The index figures are as follows :—

| Index Figures. | Station. |
|---|---|
| 61 | Croydon. |
| 62 | Biggin Hill. |
| 66 | Lympne. |
| 75 | Beachy Head. |
| 76 | Dungeness. |

In the case of Dungeness (76) only one group is sent, including the index figures and the Channel visibility there, while in the case of Lympne the last figure of the first group gives the Channel visibility from Hythe.

The word "BOTLEY," when it occurs in a message, is followed by a statement in plain language of the conditions of the North Downs (Botley Hill) as viewed from Biggin Hill, when such a statement adds material information to that contained in the rest of the message.

At the end of the messages issued at 0835, 1135 and 1435, a short forecast is given in plain language of the meterological changes anticipated in S.E. England in the period of daylight following the time of issue.

This begins with the word "FORECAST."

The complete results of a pilot balloon ascent at Croydon or Lympne, when available, are given at the end of the messages at 0735, 1135 and 1335.

This part of the message is preceded by the index figures of the station and by the four figure index group 49tt—where tt = hour of ascent (G.M.T.).

Reports similar to the above are issued from Le Bourget (ZM), Brussels (HS) and Soesterberg (STB).

In the case of the reports from Brussels and Soesterberg the codes employed are identical with those used in the collective reports for S.E. England.

Synoptic Reports and General Inferences are issued from (*a*) the Air Ministry (GFA) on 1400 metres at 0200, 0600, 0800, 0915, 1400, 1900 and 2000 G.M.T., and (*b*) from Aberdeen (BYD) on 3,300 metres at 0830 G.M.T.

# Notes

### The Postmaster-General and Broadcasting.

As we close for press, we learn that it is anticipated that an important announcement will be made in the House of Commons on Monday, May 1st, regarding the facilities to be given by the Postmaster-General for wireless telephony broadcasting.

### Amateur Wireless in Buenos Aires.

We learn that the Radio Club Argentino is progressing most satisfactorily, there being now well over 100 members. A receiving station and telephone transmitter have been installed in the club house in Buenos Aires. Amateur apparatus is now more easily obtained than in the past.

### Association des Ingénieurs (Liége).

We are notified that the celebration of the 75th anniversary of the foundation of the Association des Ingénieurs sortis de l'École de Liége is postponed one week till Sunday, June 18th, on which day the formal opening of the Technical Exhibition will take place. On June 19th, 20th and 21st, Congress meetings will take place, and on June 22nd, 23rd and 24th, excursions will be made to various technical works.

### Norway : New Wireless Society formed.

"A society has been formed in Christiania under the name of Norsk Radio-Amatörklub. The membership of the club is very rapidly increasing, showing the great interest taken in radio in Norway, an interest which has been concealed under the Government ban on amateur wireless, but which is now at last coming into its own. Our plan is to collect the necessary number of members, and then make the Government a proposal that amateur work may be permitted under certain conditions. Rules have been worked out by our committee and will accompany our proposal as a base for further considerations from both sides. In this way we hope to get rid of the absurd prohibition of amateur work.

In the meantime we propose to hold lectures and demonstrations, so as to arouse still more interest in this most fascinating science.

We shall be glad to answer questions regarding our club, both from British amateurs and especially from the other Scandinavian countries."

Address of Hon. Secretary : 30, Industrigaten, Christiania.

### Wireless Exhibition in Rome.

Arrangements are being made to hold an Exhibition of Wireless Telegraphy shortly in Rome. Eighteen firms will be represented, and different types of instruments, including the latest developments, will be shown working.

### Wireless for Polar Expedition.

Captain Amundsen, of arctic fame, is at present organising an expedition to the North Pole in which aeroplanes will be used to reach points beyond which the mother ship can go. The aeroplanes will be equipped with wireless apparatus capable of maintaining communication with the mother ship, whilst the latter will carry a sufficiently powerful equipment to be in a position to maintain communication with such relaying points as Nome and Alaska.

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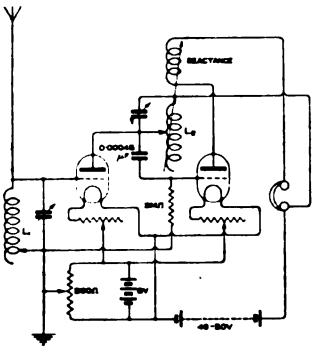
# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I and my son have experimented for several years with various receiving circuits and have decided upon a very simple two-valve circuit which gives excellent results on all wavelengths and is extremely efficient for telephony.



It may be necessary to add that tuning coil L2 must of course always synchronise with aerial tuner (single layer coils).

We have endeavoured to make the diagram as clear as possible.

W. SMITH.

P.S.—Using two "R" valves the Dutch concerts are very clear, also Croydon, Fulham aircraft telephony, and Eiffel telephony very loud.

Royal Arcade,
Weymouth.
*February 24th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In answer to your note re French Amateur Transmitting Stations of your issue of April 1st, I wish to say that I received **8 AB** (Nice) last night at about 9.15 p.m., B.S.T. His note is rather difficult to read, and appears to be rectified A.C. of about 50 cycles. The signals were of fair strength and quite steady. He asked British amateurs to "tell **2 CV** how they were receiving," but as **2 CV** has not appeared in any of your lists to date I have not his address. I may say I get **2 CV** strongly.

With best wishes for your excellent paper.

G. W. G. BENZIE.

Denmill Cottage, Peterculter,
Aberdeenshire.
*April 18th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

EVOLUTION OF WIRELESS

SIR,—I have just been looking up some of your old numbers, and it is highly interesting to note how far we have travelled in wireless during, say, the last two years. It is like a peep into the Dark Ages, and the growing army of amateurs would open their eyes wide to read some of the learned discussions on the science in those days. The infant has certainly grown apace. For instance, in your issue of June 26th, 1920, we read an account of the wonderful installation at the *Daily Mail* office. How it could detect signals so far distant as 3,000 miles! But it appears to have taken an elaborate and costly apparatus to accomplish this wonderful result on fourteen valves! True, it was with a frame aerial, but presumably a very efficient one. To-day, if we amateurs could not get readable American signals on one valve, a P.M.G. aerial and a largely home-made apparatus, we should have serious misgivings about our set. The modern amateur is stepping straight into music from the æther and realises none of our early struggles with crystals, coils, condensers and connections. One thing stands out very clear in reading these early numbers. Many pet theories have gone sky-high, and the amateur has taken a leading part in exploding them.

E. B. GRINDROD.

*April 20th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

WIRELESS "DISCOVERIES."

SIR,—All of us interested in wireless research are deeply grateful to the press for its many favours, but when one sees the crass ignorance of wireless displayed by some of our great daily and weekly newspapers one is given to wonder whether a little class of elementary instruction might not be given to the sub-editors of those journals.

The *Daily Mail*, which really ought to know better, when it set up its receiving set and did the "suit-case" stunt, astounded the world that at Carmelite House the Marconi station at Poldhu had actually been heard! I have to think for how many years we old experimenters have heard him, even on an odd piece of wire. "And the Eiffel Tower came in quite clearly," declared the gentleman who wrote the article on wireless. We have had the latter for years on an iron bedstead, an iron fence and on a little bit of wire strung up over the cabbages! When one reads articles on wireless in our daily press—and I place the *Daily Telegraph*, the *Daily News*, the *Daily Chronicle*, the *Evening News* and the *Observer* all in the same pillory—one draws a long breath at the lack of scientific knowledge displayed by those who give us our "news," or feed us upon radio science!

But the latest insult to the public intelligence is in an article, with a big printed diagram, with crystal detector, which I read in the *News of the World* of April 16th, under the title "Kissing by Wireless." The "kiss" from Miss Anderson of Brooklyn, to Mr. Hugo Estburg, chief operator on the liner "America," may or may not have been heard, but I would call the attention of my fellow-wireless experimenters to a singular fact which the *News of the World* states as follows:—

"The President of the United States is singularly fortunate, for his set can take a wavelength

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of 25,000 metres, *while the average amateur cannot receive on a wave much longer than* 375 *metres.* Under ordinary conditions the President can hear not only all the stations in the continental United States, but also those in Hawaii and Panama, although these overseas stations do not send in voice but in the Morse Code. The receiving set is placed in a bookcase near the President's desk, in the White House. A vacuum tube detector and a two-stage amplifier make up the Presidential set. Without doubt wireless telephony has captivated every class in America, and there appears to be no stopping the wave of enthusiasm."

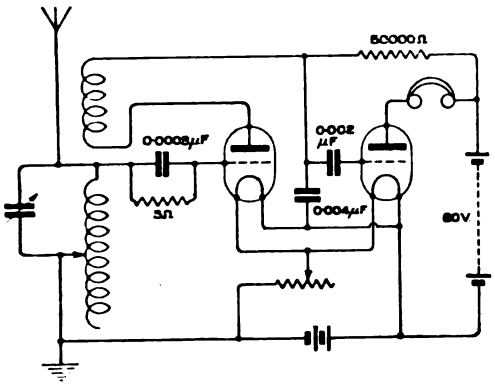
Comment is needless. Perhaps the *Daily Express* may discover I.D.O., or the *News of the World* may tell us all about Nauen. Who knows? We live in an age of discovery!

WILLIAM LE QUEUX.

Devonshire Club, S.W.

## Resistance Capacity Amplification

Mr. B. L. Stephenson, author of the paper published in the issues of April 1st and April 8th,




asks us to insert the accompanying diagram as a revision to that published with his paper on page 47 of the issue for April 8th.

## Books Received.

THE CONSTRUCTION OF AMATEUR VALVE STATIONS. By Alan Douglas. (London: *The Wireless Press, Ltd.* Crown 8vo. Pp. 78. Figs. 55. Price 1/6 net.)

THE RADIO EXPERIMENTERS' HANDBOOK. By Philip R. Coursey. (London: *The Wireless Press, Ltd.* Pp. 113. Figs. 99. Price 3/6 net.)

PRACTICAL PHYSICS. By W. R. Bower, B.Sc., and J. Satterly, D.Sc. (London: *University Tutorial Press,* Second edition. Price 7/- net).

ELECTRICITY. By Sydney G. Starling. (London: *Longmans, Green & Co.* 1922. Pp. 245. 8½" × 5½". Figs. 127. Price 10/6 net.)

LEXIQUE TECHNIQUE ANGLAIS-FRANÇAIS. By G. Malgorn. (Paris: *Gauthier-Villars et Cie.* 1920. Price 10 francs.)

## Calendar of Current Events

**Friday, May 5th.**

ROYAL SOCIETY OF ARTS.

4.30 *p.m.* — John Street, W.C.2. "Imperial Wireless Communication," by Professor W. H. Eccles, D.Sc., F.R.S.

**Saturday, May 6th.**

LUTON WIRELESS SOCIETY.

Exhibition.

**Tuesday, May 9th.**

TRANSMISSION OF TELEPHONY at 7 *to* 7.25 *p.m.* on 700 metres, followed by C.W. Calibration Signals on 1,000 metres, by **2 MT** from Writtle, near Chelmsford.

**Thursday, May 11th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Demonstration of Recording, by Mr. W. A. Brooke.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Transformer Coupled H.F. Amplification." by Mr. Edward McT. Reece.

RADIO EXPERIMENTAL ASSOCIATION (NOTTINGHAM AND DISTRICT).

7.30 *p.m.*—At the Mechanics' Hall (Room 71). Lantern Lecture, "Wireless During the War" by Mr. Carpenter.

**Friday, May 12th.**

PHYSICAL SOCIETY.

5 *p.m.*—At the Imperial College of Science, South Kensington. "Experiments with Neon Gas Filled Lamps," demonstration by Mr. S. O. Pearson, B.Sc., and Mr. H. Anson.

WIRELESS SOCIETY OF HIGHGATE.

"The Action o the Valve in the Light of the Electron Theory," by Mr. D. H. Eade.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

"The Principles of Tuning," by Mr. H. F. Yardley.

**Saturday, May 13th.**

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

*Afternoon.*—Visit to Victoria Telephone Exchange.

**Wednesday, May 17th.**

NORTH MIDDLESEX WIRELESS CLUB.

8.30 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Advantages of Sectional Wireless," by Mr. Edward McT. Reece.

**Thursday, May 18th.**

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "Electricity and Matter," by Prof. Sir Ernest Rutherford, K.B.E., F.R.S.

**Friday, May 19th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—"Valve Characteristics and the Practical Measurement of Valve Constants." by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

7 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "The Elimination of Atmospherics in Radio Telegraphy," by Mr. A. H. Reeves.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### The Wireless Society of London.

The Forty-seventh Ordinary General Meeting was held on Wednesday, April 26th, at the Institution of Electrical Engineers, at 6 p.m.

After the minutes of the previous meeting had been approved and signed, the **President** called upon Captain H. de A. Donisthorpe to open a discussion on the "Circuits of the Four-Electrode Valve." (For Report see next issue.)

At the close of the discussion the **President** announced that the following had been duly elected to membership of the Society: Rev. John Whately Pyddoke, Major J. J. F. O'Shaughnessy, H. A. Thomas, B.Sc., L. J. Hughes; and that the following Societies were accepted for affiliation: Dick Kerr Wireless Society, Preston; Nottingham and District Radio Experimental Association.

The meeting adjourned at 7.35 p.m.

### North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 89th meeting of the Club was held at Headquarters on Wednesday, April 19th. There was a good attendance, and after the minutes had been read, the Chairman, Mr. G. Evans, called on Mr. R. Maxwell Savage, B.A., to lecture on "Electro-Chemistry."

Mr. R. Maxwell Savage commenced by relating how the early philosophers speculated on the constitution of matter, but beyond arguing about the subject, they made little progress. Later, Volta made some discoveries, and he and others experimented by passing currents through liquids, and noted some surprising results. Mr. Savage then described some of these effects, and illustrated them by some experiments. He described the latest theories on the composition of matter and the nature of the atom, explaining how the atom was composed of a nucleus surrounded by electrons. He told his audience that these electrons were, in fact, particles of electricity, and explained how, when some compounds were dissolved in certain liquids, they were broken up into two or more parts, and how the passing of a current caused the split components to behave in accordance with certain laws, and made possible the process of electro-plating.

The lecturer performed a number of experiments to illustrate his remarks, showing how different an element was from the ions to which it gave rise. A silver coin, immersed in a solution of elementary sulphur, was unattacked, whereas sulphur in the ionic state at once caused brown stains to appear.

Several members had questions to ask, which Mr. Savage answered, and a discussion ensued, largely centring round atoms and their nature. The lecturer explained how scientists calculated the mass of the atom, and dealt briefly with what is known as Mendeleeff's Periodic Table. A vote of thanks was moved from the Chair and seconded by Mr. Symons, and was carried with enthusiasm.

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the Club Room at 7.45 p.m. on April 21st, Mr. W. C. Ramshaw in the Chair. Following the business of the meeting a very interesting lecture on "Aircraft and Wireless" was given by Mr. M. Eskdale, one of our most enthusiastic members. The lecture had special reference to D.F. work, which was very lucidly explained and illustrated by means of diagrams and lantern slides, which were loaned for the occasion by Messrs. Marconi's Wireless Telegraph Co., Ltd. The lecture was very much enjoyed by all present, and a hearty vote of thanks was accorded to Mr. Eskdale.

### Birmingham Experimental Wireless Club.*

Hon. Secretary, Mr. Frank S. Adams, 110 Ivor Road, Sparkhill, Birmingham.

At a meeting held at Digbeth Institute on Friday, March 31st, an extremely interesting lecture was given by Mr. A. C. Chatwin on "Wireless in the Tropics."

Mr. Chatwin described certain different types of transmitting and receiving apparatus used in the Army and very ably enumerated their advantages for different purposes. He then described the joys of a voyage to East Africa in war-time, and told of the troubles and dangers which beset the British forces in that country during 1916 and after. Some interesting photographs were passed round, which illustrated the lecturer's remarks, and showed the types of apparatus used in the East for radio-communication.

The systems of wireless communication used by the troops in Mesopotamia and India were then described, with special reference to the geographical and geological conditions existing in these countries, and their bearing on radio-work.

The lecture was full of interesting anecdotes, and was much enjoyed.

The President (Mr. A. L. Lancaster) proposed a vote of thanks to Mr. Chatwin, which was carried unanimously.

### Manchester Wireless Society.*

March 23rd. The last meeting of the winter session 1921-22 was held at The Albion Hotel, Piccadilly, Manchester, at 7.30 p.m. Mr. McKernan in the Chair.

Capt. Hollingworth (President) gave a very interesting and instructive lecture on the troubles experienced in wireless research. In introducing the subject, he confessed that what he had to say would be on the lines of unrestricted pessimism, and certainly the remarks that followed were enough to frighten the timid amateur when he realised that such pitfalls and stumbling-blocks were awaiting him in the course of his future experiments. Full of useful hints and surprising facts about the reception of wireless messages, the lecture proved very beneficial to those present, both amateur and advanced student.

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A hearty vote of thanks was proposed by Mr. Evans and seconded by Mr. Reid. The members showing their appreciation with generous applause. The Chairman then declared the meeting closed.

April 3rd. A general meeting was held at Headquarters at 7.30 p.m., Mr. McKernan in the Chair.

The Hon. Secretary read the correspondence which had passed between the Society and the Postmaster-General, with regard to the issue of a special licence for the use of 1,000 watts transmitting power.

The application was made in January with a view to attempting a transmission across the Atlantic in March or April, but owing to the difficulty experienced by the Post Office authorities in obtaining the assent of other Government Departments, the reply had been delayed, so that it was now proposed to carry out the test as early as possible, as far as the erection of the station was concerned.

It is hoped that the station will be working by the end of May, and although atmospheric conditions will be much more unsuitable at that time of the year, the test will be made as arranged.

Further particulars will be issued later.

The meeting passed a resolution, authorising the opening of a subscription list, to which members were asked to contribute, in order to raise a fund to cover the expenses of the projected scheme.

A Committee was elected for the purpose of working out the approximate cost of the undertaking.

A working Committee of twelve members was also formed to deal with the constructional details.

The meeting was then declared closed.

All wireless enthusiasts and Societies interested in the proposed test, are invited to write to the Hon. Secretary, who will be pleased to answer any questions, approved of by the Committee.

A date will be announced, on which the station will be open to the public and a general invitation will be issued to the wireless fraternity.

Hon. Secretary, Mr. Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester.

April 19th. The Working Committee, who are concerned with the erection of the high power station of the Society, paid a visit to the proposed site at Baguley, near Manchester, and after a thorough inspection they decided that with the permission of the local authorities and the Altrincham Electrical Department, the spot was ideal for the occasion.

Accordingly arrangements were made for the necessary interviews to be applied for, and all accessories to meet the requirements of the site were carefully tabulated.

A list of the gentlemen and members who will be responsible for the final details will be made known in the course of the next few days.

### Brighton Radio Society.*

At a meeting of the above Society, held at its Headquarters in Buckingham Road, on April 6th, an instructive lecture upon the construction of aerials was delivered by the President of the Society, Mr. W. E. Dingle, who described the various types of aerials in use in this country and on the continent. The lecturer furnished useful data for the information of members about to install wireless sets, stress being laid upon the importance of insulation throughout.

Lectures by prominent gentlemen have been arranged for forthcoming meetings whereby valuable assistance will be rendered to experimenters carrying out work during the present year.

Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full particulars as to membership, etc.

### Plymouth Wireless and Scientific Society.*

At the meeting held on Wednesday, April 12th, a lecture was given by Mr. L. J. Voss on "The World's High Power Wireless Stations." Starting with a description of the earliest equipment at Poldhu, the lecturer led us through the various developments of the spark system right up to the present timed-spark C.W. system installed at Carnarvon. The various C.W. systems were then dealt with, the Poulsen Arc, the H.F. alternator and the valve transmitter, including the latest mammoth valve set at Carnarvon, whose signals can be heard well in Australia. The recently opened New York Central Station and its remarkable aerial equipment were ably explained. Altogether the lecturer was a great success, being at the same time intensely interesting and highly instructive.

Full particulars of the Society may be obtained from the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

### Wireless and Experimental Association.*

The last meeting of the Association was held on April 19th at the Central Hall, Peckham. In the absence of the Secretary, an Assistant Secretary was appointed to take over the duties. A most interesting discussion took place on several points in transmitter working with choke control modulation, especially as to the precise junction of the choke.

Until further notice, all enquiries and communications should be addressed to Assistant Secretary, Mr. W. J. Joughin, 21, Troughton Road, Charlton, S.E.7.

### The Willesden Wireless Society.*

The Society met on April 11th to hear Mr. C. Dunham lecture upon the "Design of High Frequency Transformers," and, as Mr. Dunham deals with this system of reception in his daily work, some very useful and interesting hints were obtained. Mr. W. Corsham announced a rather remarkable transmission feat by his station, **2 UV**, in a test with Mr. R. D. Spence, of Huntley, Aberdeen. **2 UV**, using tonic train with only 0·09 in the aerial, was read by Mr. Spence, and this reflects great credit upon Mr. Spence's reception system.

The meeting on the 17th of April was opened by Mr. Corsham, the subject being "Low Frequency Reception," and a very interesting debate was the result, some members being for and some against, and the meeting closed with a vote of thanks to Mr. Corsham for opening the debate.

Assistant Hon. Secretary, Mr. W. E. E. Corsham, 104, Harlesden Gardens, London, N.W.10.

### Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A meeting of the above Association was held on Thursday, April 20th, at the Mechanics' Hall.

Mr. R. Pritchett, B.Sc., delivered a most interesting lecture entitled "Theory of the Valve." The lecturer, who treated the subject from a scientific

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point of view, illustrated his lecture by means of characteristic curves and also lucidly explained the method of plotting various curves. Mr. Pritchett's effort to expound a truly difficult subject was greatly appreciated by those present. Later in the evening an amusing extract from an old copy of *The Wireless World* was read by Mr. Carpenter, whose remarks about the construction of valves, their uses, methods of testing same, and general hints on how to manage them caused great amusement.

The Hon. Secretary will be pleased to afford information *re* membership, etc., to those interested.

### Croydon Wireless and Physical Society.

Hon. Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley.

At a meeting of the Croydon Wireless and Physical Society, held at the Central Polytechnic, Croydon, on Saturday, April 1st, 1922, a most interesting lecture was given by Mr. B. Hesketh on "Various Methods of High Frequency Amplification." The lecture was accompanied by some very interesting experiments with a three valve set, using as the H.F. coupling, Reactance Capacity. Mr. Hesketh explained and demonstrated the great flexibility of this method over other methods.

At the lecturer's request, the lecture was freely interspersed with questions from the members.

A very hearty vote of thanks to Mr. Hesketh terminated a very enjoyable evening.

### The Southend and District Wireless Club.

On March 24th a General Meeting was held at the Science Laboratory of the Technical Institute, Southend-on-Sea, when one of our Hon. Presidents, Mr. Finn, M.Sc., etc., gave a lecture and practical demonstration on X-rays and other interesting electrical experiments.

Spark effects in vacua at varying degrees of exhaustion were very fine, as also the floating ring experiment, etc.

Members were interested in an electrolytic rectifier for A.C., which was used in circuit with the induction coil for the X-ray experiments.

The following meeting was held at Club Headquarters, Argyle Institute, Westcliffe-on-Sea, on March 31st. Mr. Plaistowe took the chair, and after the reading of the minutes, called on Mr. Meyer to lecture on "Transmission and Reception of Short Waves."

After an extremely interesting discourse, a vote of thanks was accorded, and then a general discussion on the subject of the lecture took place and questions were answered by the lecturer.

Mr. Knipe then gave us a few practical hints on engraving of receiver panels, etc., which proved of interest to members.

On April 7th, at Headquarters, a lantern lecture was given, the subject being "Commercial Stations —Transmitting and Receiving."

Through the courtesy of Messrs. The Marconi Scientific Instrument Company, some very good slides were projected. Following this a buzzer practice for high speed readers took place, and then, after a general discussion, the meeting closed at 10 p.m.

We propose to meet fortnightly in future at the Club Room and on alternate weeks to hold field days, when apparata will be taken into the surrounding country.

Several members hold transmitting licences, so that there is always something worth listening to, especially on short waves.

Prospective members are invited to call at 300, London Road, Southend, or preferably, attend any general meeting.

### Walthamstow Amateur Radio Club.

Meetings are held weekly on Wednesdays at the Y.M.C.A., Church Hill, at 7.30 p.m.

The meeting of April 19th was devoted to practical tests and experiments with members' apparatus and some very good results were obtained. Mr. Chas. C. Biggs has kindly offered to make and present to the Club an additional amplifier, an offer which is much appreciated.

It is regretted that owing to business obligations, Mr. K. Hardie has had to resign the secretaryship of the Club and Mr. Allan, of 23, Ardleigh Road, has been elected to fill the vacancy.

The Club does not adopt a standard too high for beginners, and those in the district who are desirous of taking up wireless may derive much help by becoming members. On the other hand, experts will find the meetings interesting, as the results of the practical experimenter, however elementary, are, as everyone knows, frequently full of brilliant, though sometimes revolutionary, ideas.

### Falkirk and District Radio Society.

A meeting of those interested in wireless telegraphy was held in the Old High School, Falkirk, on Monday, 20th March, for the purpose of considering the formation of a Society. Mr. W. Milne presided and there was a large attendance. It was unanimously agreed to form a Society—to be known as the Falkirk and District Radio Society, and that endeavours be made to procure suitable rooms for the erection of an aerial, subject to the necessary licence being forthcoming. The following office-bearers were appointed: President, Mr. J. R. Laird; Vice-President, Mr. G. Walker; Secretary and Treasurer, Mr. M. B. Blackadder; Committee, Messrs. McFarlane, Grindlay, Milne and Collumbine. The Secretary's address is Glenmorag, Falkirk, and he will be pleased to hear from any intending members.

### Leamington Spa and Warwick.

Mr. Frank Sleath will hold a meeting at his private address, 31, Archery Road, Leamington Spa, at 7 p.m., on Tuesday, May 9th, to discuss the possibilities of forming a local wireless society. It is hoped to start the proceedings by listening in to the Marconi concert. Will all persons interested please attend.

### Section de T.S.F. du Club d'Aviation de Valenciennes (Nord).

The Aviation Club of Valenciennes has created a special section for the study of radio-telegraphy and telephony and meetings will be held weekly at the Lecture Hall of the Institution of Civil Engineers.

President, Monsieur G. Flayelle, 36, Rue de Mons, Valenciennes, France.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only.* (2) *Queries should be clear and concise.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *Four questions is the maximum which will be accepted at a time.*

**"S.R." (Darlington)** *sends sketch of receiver and asks* (1) *For criticism.* (2) *Value for grid condenser.* (3) *Value of grid lead.* (4) *Wavelength range.*

(1) The circuit is not very good. The condenser C would be much better across the grid coil than across the plate. With a telephone transformer the telephones should be on the positive side of the H.T. battery.

(2) The value is not critical; it depends somewhat on the wavelength, increasing with increase of wavelength. For your set 0·0003 mfd. should be about right.

(3) About 3 megohms.

(4) Probably about 4,000 metres.

**"A.W." (Harrogate).**—(1) It is impossible to specify the windings for a set if you state neither the type of set nor the wavelength range required. However, if you propose to make a crystal set, put the larger coil, wound with No. 22, in your aerial and wind the other coil with No. 26 for the closed circuit.

(2) No. 25 S.S.C. will give you 105 turns to 2¼".

**"D.H.C." (Haileybury)** *submits a diagram of a receiver and asks* (1) *For criticism.* (2) *Why the set will not oscillate.* (3) *For information about H.F. transformers.* (4) *If red-leaded joints in an iron water-pipe would make it useless for an earth.*

(1) The circuit is quite good, except that we should prefer two tuning circuits, which would minimise reradiation. Your telephones should be shunted by a condenser, the absence of which probably explains failure to oscillate.

(2) This may also be due to too small a reaction coil, dampness of the coils, poorness of material in the formers.

(3) Turn about 8 grooves an eighth inch deep in a piece of ebonite 1" in diameter. Wind each groove with No. 44 wire all in the same direction and connect alternate sections into the grid and plate circuits. Adjust the amount of wire until the best results are obtained for the desired wavelength.

(4) No. The conductivity of the water and the capacity across the joints will probably prevent this.

**"OC.S." (Horsham)** *asks* (1) *The gauge of two samples of wire.* (2) *Whether they will be satisfactory for the high resistance winding of a telephone transformer.*

(1) The silk covered wire is No. 40 and the enamelled wire is the same.

(2) These wires are hardly thin enough for the purpose; but might be used if you wound on about 8,000 turns for the H.R. winding.

**"A.L.C." (Bedford)** *asks* (1) *How to make the simplest and most efficient inter-valve transformer.* (2) *Whether it is satisfactory to use H.R. telephones with a two-valve set.*

(1) The simplest method is to make a L.F. transformer, for which see reply to **"H.C." (Brighouse)**, recently. A more efficient method for a reasonable range of wavelengths is to use a H.F. transformer, a description of which will be found on pages 780 and 781, March 18th issue.

(2) This is quite possible, but L.T. telephones with a transformer are preferable in this case.

**"L.P." (Thorpe Bay)** *asks* (1) *For windings for a H.F. transformer for* 1,000 *metres.* (2) *Ditto for* 700 *metres.* (3) *Criticism of a two-valve circuit.*

(1) See pages 780 and 781, March 18th.

(2) As above, but reducing the wire until the desired value is obtained, or increasing the thickness of paper used to separate the windings.

(3) The circuit is correct, but we should recommend applying the grid potential to both valves. Separate filament resistances are not necessary if the valves are of the same type. A two-tuned circuit would be much more selective unless liable to give radiation trouble.

**"STUMPED" (Witham)** *asks for windings for a microphone transformer for use with an iron core 3½" long.*

We cannot give the windings exactly without knowing the resistance of the microphone to be used, which may be anywhere between 1 ohm and 100 ohms. The primary winding should be about the same resistance as the microphone. This resistance should be measured. If you find it very low, wind with about No. 26; if fairly high, about No. 32. The secondary winding should be of No. 44, and will probably require about 3 ozs. The core should not be less than ½" in diameter.

**"R.W." (Nottingham)** *asks* (1) *Whether a detector can be made from Rochelle salts.* (2) *Windings for a telephone transformer.* (3) *If a 2 mfd. condenser can be used with a variable condenser to increase the wavelength.* (4) *Material required for the manufacture of a grid condenser and leak.*

(1) We have no experience of the rectifying power of this substance. You might try and see.

(2) A telephone transformer is seldom efficient with H.R. telephones, but you should get fairly good results if you use a closed iron core with about 4 ozs. of No. 44 on each winding.

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(3) No; capacity is much too big.

(4) Mica, tinfoil, a piece of slate, a lead pencil and a few terminals.

"**E.B.C.**" **(Birmingham)** *submits a diagram and asks why he is unable to receive signals.*

The diagram shown should be quite satisfactory. We are unable to say why it will not work, except that there should be a condenser across the telephones. Possibly the reaction coil is reversed, the grid condenser or leak faulty or the valve defective.

"**W.A.S.**" **(Kilburn)** *asks for a good four-valve circuit to comply with certain requirements.*

It is not efficient to spend a lot of money on a number of valves and at the same time to be content with the poor results which are unobtainable from a single circuit tuner. A good all-round set for use of wavelengths of above 700 metres is shown in the diagram (Fig. 1).

"**S.B.**" **(Blackburn)** *asks for details of parts of a circuit sketched.*

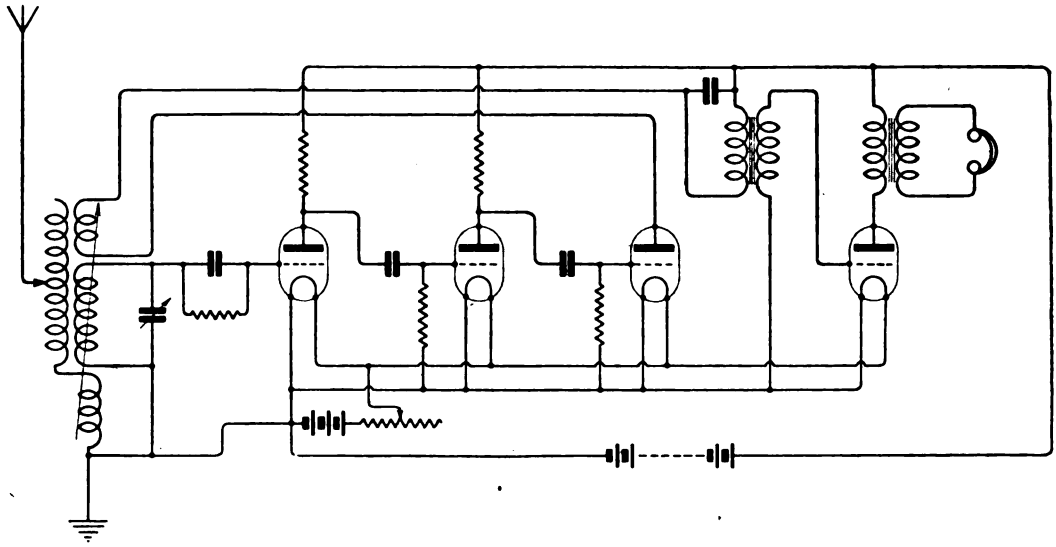

*Fig.* 1.

Coils S and T would depend on the wavelength required. Up to 5,000 metres S might be 8″ × 5″ of No. 26; T 5″ × 3″ of No. 30, with a few tappings. Anode resistances, 50,000 ohms; grid leaks about 2 megohms; telephones, 8,000 ohms or preferably 120 ohms with a transformer. Condenser P, 0·0008 mfd.; H.T. battery 80 volts, L.T. 6 volts; grid leak may be made by rubbing down pencil lead into a piece of slate, but on the whole it is better to buy one.

"**C.A.C.**" **(Hampstead)** *submits a circuit and asks* (1) *Wavelength of the A.T.I.* (2) *If the reaction coil should have tappings.* (3) *If he should get* **PCGG.** (4) *If there is a Wireless Society in Hampstead.*

(1) Coils do not have wavelengths for any useful purpose. Inductance is about 30,000 mhys., which with a 0·001 mfd. condenser should tune to about 9,000 metres.

(2) Yes, about half-a-dozen, preferably with dead-end switches.

(3) This can be done with a set of this type, but you may have difficulty with coils for such long wavelengths.

(4) No.

"**J.D.D.P.**" **(Whitchurch)** *asks* (1) *If an aerial 25′ high in a valley would give signals on a simple crystal set.* (2) *If the horizontal wire can be connected with downlead by twisting only, without soldering.* (3) *What is meant by screening.*

(1) Results will probably be rather poor.

(2) This is undesirable, as a twisted joint may work loose.

(3) The surrounding of part, or all, of the circuits with earthed metal sheets, generally for the purpose of reducing induction effects, or the absorption of signals in near-by conductors.

"**G.A.W.**" **(Stratford)** *asks* re *the valve and crystal set of issue No.* 2, *Vol.* 8 (1) *If the set will receive telephony and* **PCGG.** (2) *If not, for additions necessary to do so.* (3) *If 20′ is high enough for the aerial.*

(1) The sets should receive telephony, including **PCGG,** if skilfully used.

(2) An additional note magnifying valve would improve results.

(3) Yes, for fair results, but a greater height is desirable.

"**R.H.P.**" **(King's Norton)** *has a set which gives trouble with the carrier wave when receiving telephony, and asks* (1) *If a grid condenser and leak will improve matters.* (2) *What other addition to the circuit would help with the carrier wave.* (3) *Describes very poor results with* **2MT** *on February 14th, and asks if he can reasonably expect to get these concerts.* (4) *For any general advice on telephony reception.*

(1) No.

(2 and 4) Results probably due to too tight

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reaction coupling. Also a condenser across the telephone transformer primary would probably help; capacity 0·001 mfd. The great point in receiving telephony is to use only sufficient reaction to approach the oscillating point without actually making the set oscillate.

(3) We believe that the modulation of 2MT's transmission was very poor at about that date. It has since been considerably improved and you should now have no difficulty in getting the concert.

**"D.G.L." (Southborough)** *asks* (1) *Which of two circuits is the better for telephony.* (2) *Particulars of A.T.I. to tune* 5,000 *metres with a* 0·002 *mfd. variable condenser.* (3) *If this set will receive* PCGG *on a* 5′ *square frame mounted at about* 30′ *high.*

(1) Fig. 3, page 674, is somewhat the better.

(2) About 8″ × 5″ of No. 26.

(3) It might do so with careful handling. Very little is gained by raising the frame 30′ above the ground.

**"E.A.F." (Stepney)** *asks* re *the Marconi Type* 31*A Receiver* (1) *Wavelength range for each position of the jigger switch.* (2) *Whether single or balanced crystals have special advantages for certain wavelengths.* (3) *When to use E* 1 *instead of E, and why.* (4) *How to tell when the crystals are in a sensitive state.*

(1) Range 1 tunes to about 650 metres, range 2 to about 1,450 metres, range 3 about 3,000 metres.

(2) No. Balanced crystal working is useful when atmospherics are bad.

(3) Use E1 on very short wavelengths, as doing so introduces a small series condenser into the aerial circuit.

(4) Most easily by buzzing the aerial, and adjusting on these buzzer signals.

**"S.O.S." (Birmingham)** *wishes to add a valve to a Mk. III tuner, and asks for advice.*

This tuner was designed for short wave work and the addition of a valve will not greatly increase its efficiency. The valve can be used as a detector in place of the crystal by connecting the valve terminals to the grid and filament. It would be more useful, however, as an L.F. amplifier with the telephone terminals connected *via* a step-up transformer to the grid and filament of the valve. The addition of a loading coil will not allow the Dutch concert to be received. For an article on the conversion of this tuner, see March 5th and 19th, 1921, but it would probably be better to dismantle the set and use the parts.

**"SHORT WAVE" (Devon)** *asks* (1) *If permission is necessary to change from an outside to an indoor aerial.* (2) *Particulars of an indoor aerial.* (3) *If American amateurs are still transmitting on short wavelengths.* (4) *If it is possible to receive them with two valves.*

(1) Notification of any proposed change of this nature should be given to the P.M.G.

(2) Hang up several wires parallel to each other as long as possible and spaced a few feet apart. Connect them in parallel. Do not wind to and fro. We do not recommend this type of aerial.

(3) Normal transmission is going on on various short wavelengths, but no special attempt is being made to transmit across the Atlantic.

(4) No, highly improbable.

**"A.J.C." (Crouch End)** *asks* (1) *How to add a valve to an existing crystal set.* (2) *Which is the better use for a valve as amplifier or detector.*

(1) Connect the grid and negative side of the filament to the existing telephone terminals and connect the telephones in the plate circuit between the negative H.T. and the L.T. battery.

(2) If you have an efficient crystal set the valve will give best results as an H.F. amplifier.

**"D.J.M." (Thornton Heath)** *asks if a wire like the sample submitted could be used for telephone transformer for the frame aerial set of Vol.* 8.

The wire is No. 38 S.C.C. It could be used for the primary winding, but it is too fine for the telephone winding. For the primary wind on 10,000 turns.

**"S.R." (Barcelona)** *asks* (1) *Why a certain valve L.F. set does not magnify very well.* (2) *For the wave range of a basket coil tuner.*

(1) This set should certainly give more amplification than twice. Possibly the filament battery is reversed, or there is a disconnection in one of the windings.

(2) We cannot give you much assistance about this tuner as you do not state the size of the coils or the capacity of the condenser. However, thirty coils in the aerial will probably want more than three coils in the reaction. It is quite possible that the last few coils do not make much difference to the wavelength, so that the same stations will be heard on all of them.

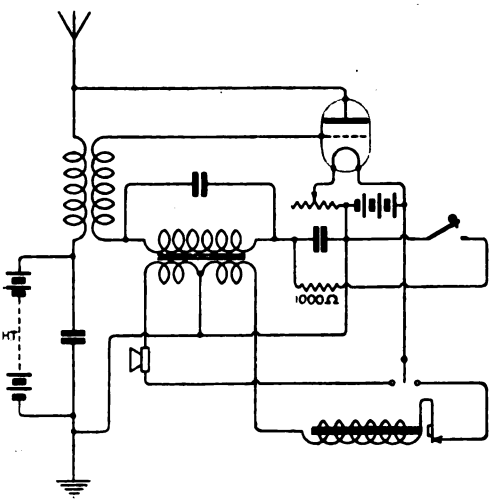


*Fig.* 2.

**"DOT DASH" (Cape Town)** *asks* (1) *For a one-valve circuit to use certain apparatus.* (2) *For a single valve transmitting circuit for C.W., telephony and tonic train.* (3) *Wavelength of a certain loose coupler set.*

(1) See Fig. 2, page 811, March 18th issue, and Fig. 4 of the same issue.

(2) See diagram. Fig. 2.

(3) With a 0·0005 mfd. condenser across the secondary both circuits will tune to 3,500 metres on a 100′ single wire aerial.

**"J.W.M." (Bethnal Green)** *asks* (1) *Wavelength of Pulham.* (2) *Wavelength of Southwold.* (3) *Whether loading coils should be connected in*

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*secondary when one is used in aerial circuit.* (4) *The amount of H.T. required for more than one valve.*

(1) Telephony 900 metres C.W.

(2) No definite information.

(3) Not necessarily. The inductance of the secondary circuit may be high enough without this addition to tune the circuit to the same wavelength as the loaded aerial circuit.

(4) All the valves being in parallel across the H.T. battery, only the same voltage is required as for one, that is about 60 in your case.

"**RADIO-LANTIC**" (**Newark**) *asks if a certain station transmitting on* 7,850 *metres is Glace Bay.* (2) *Why different call signs are given for some stations in the Wireless World Supplement of January 2nd and in the "Wireless Pocket Book and Diary."* (3) *Names of stations of which certain calls are given.*

(1) Most probably.

(2) For duplex working it is necessary for the receiving station to be some distance away from the transmitting station, in which case each station generally has a call sign allotted to it. For instance, you quote **NFF** and **WII** for New Brunswick. **NFF** is the true call of New Brunswick and **WII** the call of its receiving station at Belmar, on which its traffic is usually handled.

(3) **BWQ** Queenstown, **GKR** Wick, **TIF** Tiflis, **TCHK** Tashkent, **WSEM** general call for Russian stations. Remainder of calls no information.

"**C.M.McC.**" (**Clapham**) *asks if it is possible to increase the wavelength of a set from* 2,500 *to* 30,000 *metres by means of a loading coil.* (2) *Amount of wire and size of former.* (3) *Turns and gauge of wire for an intervalve L.F. transformer.*

(1) This might be done by a series of coils with appropriate increase of reaction coil. A single loading coil would hardly be efficient.

(2) We should recommend you to buy, or make, a series of slab coils, increasing in size to about 1,200 turns with a mean diameter of 3".

(3) See reply to "H.C." (Brighouse).

"**E.A.W.**" (**Bromley**) *wishes to receive telephony and asks* (1) *If an aerial under the roof would be satisfactory.* (2) *How many wires to use.* (3) *Whether to use one or two valves.* (4) *If one valve sets are successful for Dutch concert.*

(1) Fairly, if well arranged.

(2) Four or five in parallel.

(3) Not less than three with an aerial of this sort.

(4) Single valve sets will pick up **PCGG** with a good aerial if skilfully used under favourable conditions, but do not give very strong signals. For enjoyable results more magnification is desirable, and this is almost essential with the poor type of aerial you propose to use.

"**C.S.**" (**s.s. "Collegian"**) *asks for winding of three variometer formers for wavelength from* 300 *to* 30,000 *metres.*

It is undesirable and difficult to obtain big ranges of wavelength of this nature by means of variometers, as the losses in these coils are very considerable when they are very big and have their windings opposed. It is seldom possible to make a variometer with maximum inductance of more than seven times its minimum inductance. For a range of 300 to 30,000 metres you will need at least five variometers. The determination of suitable sizes would be best obtained experimentally, but in view of their poor performance we do not think this would be worth while.

"**KEEN**" (**Emsworth**) *has a single valve set on which he can hear only ships and asks* (1) *For criticism.* (2) *For additions to increase the range to* 4,000 *metres.* (3) *If* 750 *ohms telephones need a transformer.*

(1) For wavelengths above that of ships a loading coil of No. 30 will introduce too much resistance into the aerial circuit. The coil should be made larger and wound with No. 24 or No. 26. As at present arranged the maximum wavelength is about 3,000 metres, so that **FL** should be heard.

(2) An additional inductance in the secondary circuit is all that is required to obtain the increased wavelength. We cannot say how much without more precise information about the condenser. A reaction coil coupling with the secondary will be a great improvement. Try a 3" former, wound for 6" with No. 36.

(3) No.

**W.B.B.** (**Dublin**) *asks* (1) *For information regarding the 52a Aircraft set.* (2) *If a three or four valve set would receive telephony concerts.*

(1) We are sorry that we have no information about this.

(2) Yes, with efficient intervalve coupling and carefully adjusted reaction.

"**R.T.H.**" (**North Devon**) *asks* (1) *If a set shown will receive the Dutch concerts.* (2) *What is the use of a filament resistance.* (3) *The meaning of the Paris time signals.* (4) *The power required to transmit* 3 *miles.*

(1) Yes, if properly adjusted. Connect a 0·001 mfds. condenser across the winding of the L.F. transformer in series with the reaction coil.

(2) As you are only using a 4-volt filament battery no resistance is required. The majority of valves require at least 4·5 volts across the filament, in which case a 6-volt accumulator with a resistance is used.

(3) This is a time vernier sent on sidereal time. The dots are 49/50ths of the sidereal second. Eight figure groups give times of 1st and 300th dots in sidereal time and can only be used in conjunction with a sidereal clock.

(4) This distance could easily be covered by a 10-watt valve set. Five watts should be sufficient with an efficient set.

"**DIELECTRIC**" (**Wimbledon**) *asks what are the objections to the use of oil for a dielectric of variable condensers.*

There are no serious objections, but the chief to our mind is the messy nature of such a condenser, especially in the event of a leak in the container or overturning of the condenser. An oil condenser cannot conveniently be mounted on a panel with other apparatus. Electrically it is quite good.

"**P.Y.**" (**York**).—Your crystal circuit is wrongly connected. See Fig. 5, page 642, January 7th issue, and connect up accordingly, either with or without condensers. Use 4,000 ohm telephones, or else 120 ohms with a transformer. You should hear ships and possibly **FL** if the A.T.I. has sufficient winding.

"**P.J.D.**" (**Dublin**) *asks* (1) *Why no signals are received on a five-valve set.* (2) *For a suitable reaction coil for* 2,500 *metres.*

(1) The scheme of connections is correct, but it is quite possible that some of the component resistances

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are defective. Partially disconnect the amplifier so that each part may be tested. Try the telephones in the first anode to begin with and test preferably with buzzer signals. When you have got this valve right add another, and so on. Eighty to 100 volts will be required for this set.

(2) Make a 3" former to slide into the primary and wind with 6" of No. 30.

**"D.H.B." (Wisbech)** *asks* (1) *For a diagram of a microphone amplifier with parts.* (2) *If 4,000 ohms telephones are suitable for a three-valve set.*

(1) We are sorry that we do not know of a suitable type to recommend. The only satisfactory type that we know is the Brown relay, which is described in many text books, but this instrument is not suitable for amateur construction.

(2) Yes, if there is no telephone transformer.

**"A.S." (Coventry)** *asks* (1) *How to arrange capacity reaction for a single valve set.* (2) *For the issue in which a single valve set was described.*

(1) Connect the reaction condenser between the grid and anode of the valve. A suitable condenser may be made of a ½" glass test tube, coated inside and out with tin or copper foil. One coating should be made a sliding fit to allow of the adjustment of the capacity of the condenser. Capacity reaction in a single valve circuit is liable to give very erratic results.

(2) February 5th and 19th, and March 19th, 1921, issues.

**"R.B.R." (Streetly)** *asks* (1) *If crystal set described will receive the Dutch concerts.* (2) *If it will be improved by the addition of a valve magnifier or a telephone transformer.* (3) *For an efficient set to make or buy with approximate cost.* (4) *Meaning of high tension.*

(1) The set is not sufficiently sensitive for this purpose. At least two valves will be required for weak speech.

(2) A note magnifying valve will increase signal strength and bring in the English concert.

(3) Try making a single-valve set as shown on Fig. 2, page 811, March 18th issue, or that shown in Fig. 4 of the same issue. It would cost £3 to £4 with valve and batteries.

(4) In wireless receiving the term is used to denote the anode or plate voltage of the valve. It is called high-tension, or voltage, because the potential of this battery is greater than that of any other battery used on the set.

**"R.T.C." (Herne Hill)** *asks* (1) *For a loose coupler for 3,000 metres for a crystal set.* (2) *If it can be used later for a valve set.*

(1) A.T.I., 6" × 10" of No. 24. If a 0·0005 mfd. secondary condenser is used the secondary may be 5" × 8" also of No. 24.

(2) Yes, it can still be used with the valve gear connected across the secondary condenser in place of the crystal and telephones.

**"J.W.H.C." (Nuneaton)** *asks for a non-technical description of a simple and inexpensive Morse writing apparatus for use with his set.*

Instructions for the construction of such apparatus will take more space than we can give. We may say, however, that for recording on the three-valve set you will need a good quality relay sensitive to about ¼ milliamp. The construction of this piece of apparatus is beyond the power of any but a very exceptional amateur. A suitable relay of P.O. type will cost about £12. The relay should be used to work the inker by means of a local battery. The inker itself may be made by an amateur and consists essentially of a clock-work mechanism to draw paper tape in front of an ink wheel and a magnetic arrangement to force the ink wheel against the paper when the relay is operating.

**"W.T." (Carnforth).**—The jamming you complain of is surprisingly bad for a DC system and points to neglect of the machines at the generating station. We are afraid you can do little to cure it except removing your aerial as far as possible from the wires, putting it at right angles to them, and, if you still get induction with the aerial disconnected, screening all your instruments in large closed iron boxes.

**"C.W." (Greenwich)** *sends* (1) *A circuit for criticism, and asks* (2) *If a grid leak and condenser will improve the set.* (3) *If the set will give* **PCGG.** (4) *If the set shown on page* 781, *February 5th*, 1921, *should be connected as in his diagram.*

(1) and (4) The set is quite all right. The small differences you have made are quite immaterial. The grid condenser and leak (0·0003 mfd. and 2 megohms) might slightly increase the sensitiveness, but would necessitate the use of more H.T. volts.

**"BOBBIN" (Walsall)** *asks* (1) *The best form of radiator for a Wilson coil set.* (2) *Information about the efficiency of frame aerials.* (3) *Correct spacing between turns for a receiving frame.* (4) *If a narrower frame is better for direction finding.*

(1) Your results show that an open aerial gives best results. The artificial aerial condenser was not of large enough capacity. It should be quite possible to get the set to work satisfactorily on a closed circuit, but the radiation will be much poorer than on an open aerial. (2) The two-layer frame may be used provided its natural wavelength does not come out higher than the minimum wavelength to be received. (3) This varies with the size of frame, wavelength, etc., but as a rule it need not be greater than ⅛ inch. (4) In practice there is little to choose between them.

**"C.G." (Coventry)** *wishes to add three valves to a Mark III Tuner.*

There are many possible three-valve circuits, most of which have been given in these columns. Try any you fancy. Connect the valve terminals on the Mark III to the input terminals of the amplifier. A possible rearrangement of the Mark III circuits themselves for reaction purposes is given in the issue of June 25th.

**"EXPERIMENTER" (Bourne End)** *asks* (1) *A question about certain H.F. transformer formers.* (2) *If capacity reaction is as good as magnetic reaction.* (3) *Best ratio for L.F. transformers.* (4) *Best combination of three valves.*

(1) Not suitable for short waves or for wide wave ranges, but quite good for long waves. (2) Under the best conditions of each not a lot to choose between them, but as a rule capacity reaction is more difficult to handle and liable to be erratic. (3) This depends on a variety of circumstances. The best value usually lies between 1/1 and 1/3. (4) One H.F., one detector, and one L.F. for general purposes. Two H.F. and one detector is also very good for obtaining some results from very weak stations.

**"C.F.W." (Nottingham)** *asks* (1) *For criticism*

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*of a three-valve set.* (2) *Best earth without using a water-pipe.* (3) *A book on telephony transmissions.*

(1) The set is O.K., but it will be better to connect the reaction coil to the anode of the second valve, with a 0·001 mfd. condenser across the intervalve transformer winding which is in that circuit. (2) Either a large metal plate should be buried in the ground, or a considerable length of wire netting laid along the ground. (3) We do not know of a book that will exactly suit your purpose.

"**H.W.H.**" **(Taunton)** *asks* (1) *For windings for the choke of an impedance amplifier for* 150 *to* 4,500 *metres.* (2) *For windings for a C.W. transmitter.* (3) *For the capacity of a condenser.*

(1) We do not think you will get at all satisfactory results with this amplifier at less than 1,000 metres. Above 1,000 metres you would probably find an ounce of No. 42 wound on a long iron core satisfactory. (2) You give no particulars of your aerial so we cannot give you exact windings, but about 50 turns of No. 20 on a 3" diameter former for the anode coil, and 3" of No. 30 on a 2½" former for the grid coil will probably be sufficient for short wave work. (3) You do not mark your diagram to show which condenser you refer to. The condenser across the H.T. may be about 0·005 mfds., and the condenser across the break may be 0·001 mfd.

"**SCOUT-PADD**" **(Maida Vale).**—It is not easy to give a reason without direct experiment. Try increasing the L.T. voltage to six, and also reaction between the grid and plate of the first valve only.

"**S.A.B.**" **(Wimbledon)** *refers to Fig.* 12, *page* 726, *February* 18*th issue and asks* (1) *If the telephones should be short-circuited as shown.* (2) *How many plates to use for a* 0·0001 *mfd. air condenser.* (3) *What anode resistance to use for "Ora" valves.* (4) *Wave range of a certain circuit.*

(1) No, this is a mistake. The lead which short circuits the telephones and blocking condenser should be omitted. (2) If the plates are 2" diameter, separated by $\frac{1}{16}$", you will require about 10 fixed plates and 9 moving. (3) 30,000 to 50,000 ohms. (4) It depends on the coils and the condensers used, about which you say nothing.

"**W.H.**" **(Salford)** *asks* (1) *Which is the better of two aerials.* (2) *If iron guttering under one end of an aerial will affect signals.* (3) *Times of transmission of Wakefield and Halifax.* (4) *If an indoor aerial would be effective with a one or two valve set.*

(1) The two wire aerial. (2) Not to any appreciable extent. (3) We have no information. (4) It will give fair results if the aerial is carefully arranged, but of course, signals from any but nearby stations will not be at all loud.

"**ANXIOUS**" **(Windsor)** *asks* (1) *If an earth lead need be insulated.* (2) *For a practical book on loud speakers.* (3) *Filament voltage for three "R" valves.*

(1) No. (2) We do not think there is such a book in existence, but a very useful article appeared in the issue for February 19th, 1921. (3) Connect the three valves in parallel and use a six-volts battery with a small series resistance.

"**R.A.F.**" **(Doncaster)** *asks* (1) *For winding for a former* 2½" *diameter for* **PCGG** *with a circuit of Fig.* 12, *page* 726. (2) *If circuit shown is suitable for* **PCGG.** (3) *Gauge and quantity of wire for H.F. transformer for* **PCGG** *on former* 1½" *diameter.* (4) *Ratio for L.F. and telephone transformers.*

(1) 10" long of No. 24, say, 4 ozs. (2) Yes, if a 0·001 mfd. is connected across the anode winding of the first L.F. transformer. Wind for 4" with No. 28. Inter-valve about 1/2 step-up, telephone 8/1 step-down.

"**H.G.P.**" **(Ramsgate)** *asks* (1) *How magnetic reaction is used with slab tuning coils.* (2) *How to make a reaction coil for the same.* (3) *How many ohms to a megohm.* (4) *If possible to hear* **PCGG** *distinctly on a two-valve set at Croydon.*

(1) and (2) One slab is used as a tuning coil and another placed on top of it, and connected in the anode circuit is used for the reaction. Reaction coupling is varied by separating the coils as desired. (3) One million ohms. (4) Yes, when Croydon air service station is not working.

"**H.A.K.**" **(Herne Hill).**—We are sorry that we have no information regarding the French crystal receiver. We should recommend you to write to the Société Française Radio-Electrique, 79, Boulevard Houssmann, Paris, for a two-valve set (*see* Fig. 3, page 812, March 18th issue). In place of the magnetic reaction a small variable condenser should be connected between the anode of the second valve and the grid of the first.

"**P.M.G.**" **(Coventry)** *asks* (1) *If a crystal set shown is suitable for* 2,800 *metre stations.* (2) *If Sullivan 'phones will work with Brown telephone transformers.* (3) *If an aerial described is satisfactory.* (4) *If a circuit shown for* 6,000 *metres will receive speech.*

(1) The diagram is quite correct for an elementary set. The wavelength range will depend on the size of the coil, which you do not describe. (2) and (3) Yes. (4) Circuit is not complete. A variable condenser is necessary across the secondary circuit. The only station we know of sufficiently near you to give telephony on a crystal set is the Birmingham air station.

## Company Notes.

"The Directors of The Ever Ready Company (Great Britain), Limited, recommend the payment of a Final Dividend for year ended March 31st, 1922, of 5½ per cent. on the Preference Shares, making 9 per cent. for the year, and 9 per cent. on the Ordinary Shares; both payable on June 1st, 1922. Accounts will be issued on May 9th. General Meeting, May 31st."

## SHARE MARKET REPORT

Prices as we go to press on April 28th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 8 | 6 |
| „ Preference .. .. | 2 | 7 | 6 |
| „ Inter. Marine .. .. | 1 | 10 | 0 |
| „ Canadian .. .. | | 11 | 0 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | 1 | 5 | 0 |
| Preference .. .. .. .. | | 17 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

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## The Reinartz Tuner

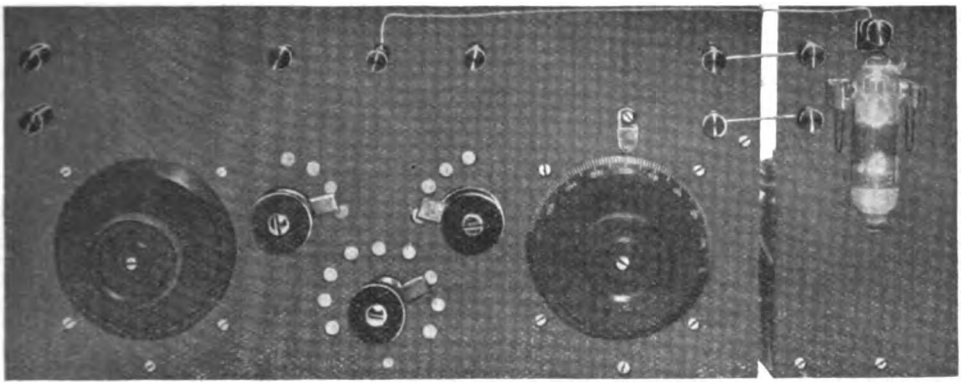
### A NEW IDEA IN SHORT WAVE RECEPTION

By PERCY W. HARRIS.

THE successful completion of the Trans-atlantic Amateur Tests has achieved two things. On the one hand, it has drawn attention to the high efficiency of transmission on short waves, and on the other it has emphasised the superiority of C.W. for this purpose. In America, where transmitting licences are much more freely granted, the latter point has aroused the greater interest, for there the efficiency of short waves was already well known.

The wider adoption of C.W. for short wave transmission in the United States has been considerably hindered by the difficulty (only to be realised by those who have attempted it) of constructing and operating satisfactory C.W. tuners for the short waves. The "standard American regenerative receiver" which uses very loose aerial coupling, variometer or condenser grid tuning, and a tuned plate circuit (variometer tuned), has reached a high degree of efficiency, but is difficult to handle, owing to the need of simultaneously tuning of all three of the oscillating circuits. The difficulties met with in tuning to damped waves, for which these tuners were primarily designed, are, however, trivial compared with those encountered in tuning to C.W. signals, as will be understood when we consider that a variation of a twentieth of a metre in wavelength on a 200 metre adjustment is sufficient to change the frequency of the heterodyne note from 500 to 1,000.

In England this type of tuner, in which the plate circuit is tuned and coupled to the grid circuit by the internal capacity of the valve itself, has never been very popular, partly because short wave work has not been greatly developed here (the circuit functions best below 450 metres) and partly because most British amateurs have accustomed themselves to electro-magnetic reaction by means of a coil in the plate circuit coupled to a grid circuit preceding it. This latter arrangement, whilst convenient to handle on longer waves, and much simpler to tune than the American regenerative type, is often found difficult to handle on short waves, and in unskilled hands tends to burst into oscillation when critical reaction is aimed at.



*A front view of the Reinartz Tuner with detector panel.*

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With these considerations in view, the writer recently read with some interest the description published in the American wireless magazine, "QST" for June last, of a new C.W. and spark regenerative short-wave tuner for which the following advantages were claimed :—

(1) It would oscillate nicely at whatever wavelength the grid circuit were tuned to.

(2) No continual adjustment of coupling and no *aerial tuning* were needed.

(3) It was only necessary to set the tuner either to oscillate *or regenerate without oscillating*, whereupon the tuning could be carried out on *grid circuit tuning condenser alone*, without other adjustment.

(4) It was free from "capacity effects" due to the proximity of the hand.

This remarkable tuner was ascribed to Mr. John L. Reinartz, of South Manchester, Connecticut, and sufficient details were given to enable those who would to construct it.

In the March, 1922, issue of "QST," there appeared a further article entitled "The Improved Reinartz Tuner," wherein it was stated that since the publication of the previous article "hundreds of enthusiastic letters from individual readers of 'QST' report the construction of as many sets, which in every case are performing as well as, or better than we said, to the surprise and delight of their owners." The article showed several improvements which had been introduced by Mr. Reinartz and further constructional details were given. In view of these statements the writer decided to construct the tuner for himself so as to test the certainly remarkable claims made for it. The result of his tests convinces him that many other British amateurs will be glad of particulars and constructional details.

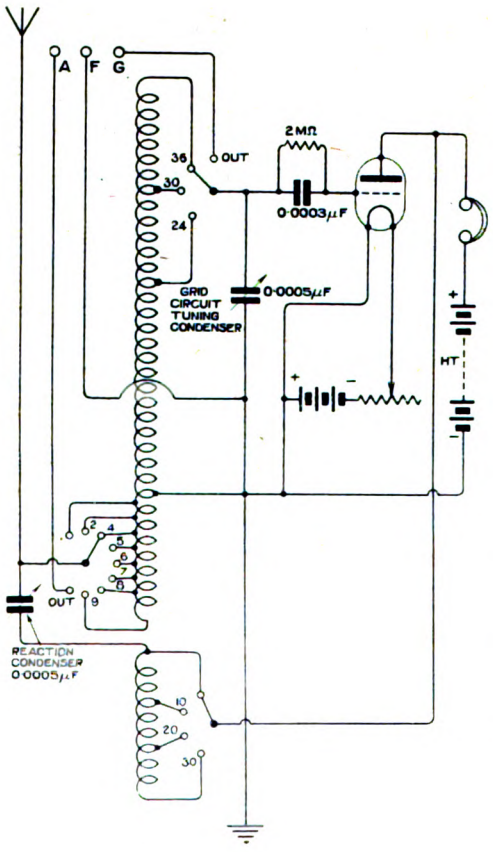
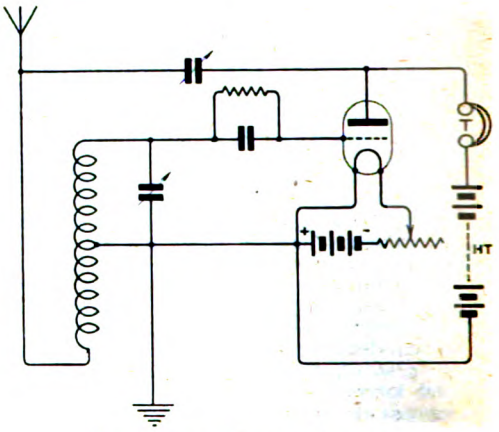



*Diagram of connections.*




*Circuit when using exterior coil.*

The tuner is of great interest apart from the claims justly made for it. An inspection of the circuits on this page will show the reader that there are many points of novelty. Firstly, the aerial circuit, instead of being coupled in the usual way, functions aperiodically, and is left on one adjustment over a wide band of wavelengths. When readjustment is made it is not for tuning purposes, but rather to alter a coupling effect. The switch connected to the aerial should therefore be regarded differently from the usual aerial tuning inductance. The aerial circuit can easily be traced through the switch and the particular stud on which it is set to earth. Frequently, good results are obtained with *only one turn of wire in the aerial circuit*. The aerial coil is continuous with the grid coil, and is therfore very tightly coupled to it. The grid coil has tappings so that the best combination of capacity and inductance can be found for a particular wavelength range. These will be seen at the top of the coil.

Particular interest attaches to the method of obtaining reaction, by a combination of electrostatic and electromagnetic effects. It will be seen that the plate of the valve is connected through an inductance (wound on the same former, and variable in four steps) to a condenser connected to the aerial. According to the setting of the inductance and condenser, so will the set regenerate to the desired degree, without oscillating, or oscillate at a chosen intensity. This will be explained in detail later. Incidentally, on the proper setting, there is practically no "backlash."

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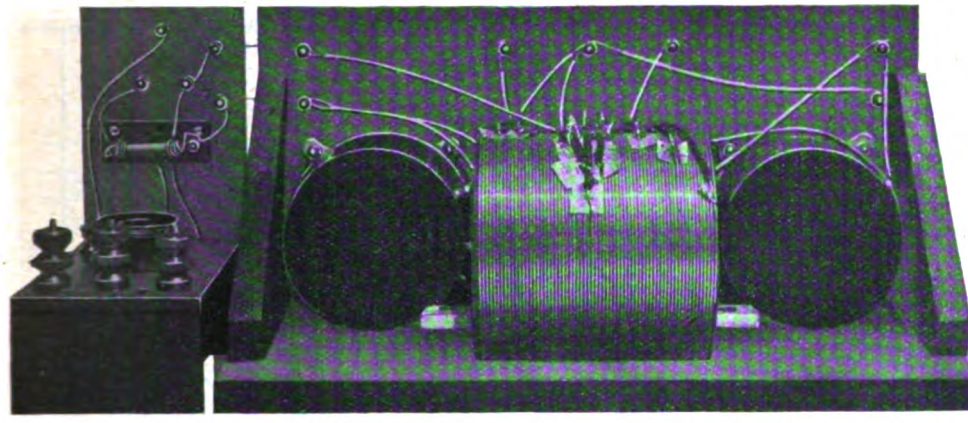
It will also be noticed that this tuner utilises a parallel or shunt supply of its high tension. For this reason there must be no telephone condenser, or if a transformer is used, any condenser across its primary winding, otherwise the high frequency current will not take the right path. If high resistance telephones are used, it will generally be found that their impedance is high enough to prevent leakage, but if a note magnifier is attached, the impedance of the primary will probably be too low, and an iron-core winding of some sort (the writer uses the intact winding of an old army-type intervalve transformer) should be inserted in series. Two other points in connecting up should be noted. The filament connection from the tuner must be made to the *positive* low tension, and the negative high tension must be connected to the positive low tension also. This point, through the tuner, is earthed.



*A back view of the tuner and detector panel.*

As described by the inventor, the tuner is made with a basket coil, but the writer has found it more convenient, and, he believes, more efficient, to construct it with a single layer solenoid with spaced turns. Particulars are therefore given of this form, but obviously the flat coil can be used if desired.

Reference to the photograph of the front of the instrument shows seven terminals, two condensers and three switches with four, four and nine studs respectively. The two terminals on the left-hand side are connected to aerial and earth, the two on the right to *plate* and grid (not grid and filament as might be expected) while the centre terminal is connected to the positive filament terminal. Alternatively, the positive of the L.T. battery may be earthed instead. The remaining two terminals (to the left and right of the central terminal), are used for connecting an external coil for longer wavelengths, in a way presently to be explained.

Of the switches, the lower with nine studs is that for the aerial. The upper left-hand switch controls the plate windings and the upper right-hand switch the grid turns. The left is the reaction condenser and the right the grid circuit tuning condenser, which should preferably be about 0·0005 mfd. The reaction condenser is better a little larger than this, although the writer uses a pair of the smaller Mark III condensers, both about 0·0005 mfd. maximum. These are quite satisfactory.

There are really two coils, one for the plate circuit and the other for the aerial and grid circuits, as shown in the diagram. Both must be wound on the same former, in the same direction. It is therefore only necessary to wind one coil, the winding being cut when the required number of turns for the plate circuit have been wound on.

It will be found easy and convenient to use one of the empty formers from an old Mark III. tuner, as the groove cut on these formers enables the windings to be spaced well. With the tappings given later the tuner will then tune down below 130 metres and up to about 325 metres, and will give perfect control of oscillation and regeneration over the whole range. If longer waves need to be tuned in, a very simple arrangement enables a very wide range to be covered. For this the three top terminals come into play.

Referring once more to the diagram of connections, it will be seen that the aerial switch has one stud (the lowest) connected to the top terminal marked A. The grid switch also has a stud connected to a top terminal G. The central terminal is earthed as shown. When using exterior coils, the aerial and grid are placed on these studs and the plate switch on the top stud. The interior coils are then cut out entirely. For 600 metre work, Mr. Reinartz recommends a coil of 70 turns of No. 26 wire (DCC is best) on a former 2¾ ins. in diameter, tapped at 20 turns from one end. The extremities of this coil are connected to the A and G terminals, and the tapping to the terminal in the centre (F). The 20 turns should be between A and F, and the 50 between F and G. Tuning is then carried out solely on the grid condenser, the aerial being untouched. Reaction takes place on the reaction condenser alone, there being no plate coils in circuit. A diagram of the connections when using exterior coils is given in the right hand diagram on page 190. The writer has used a coil with about 40 turns in the aerial

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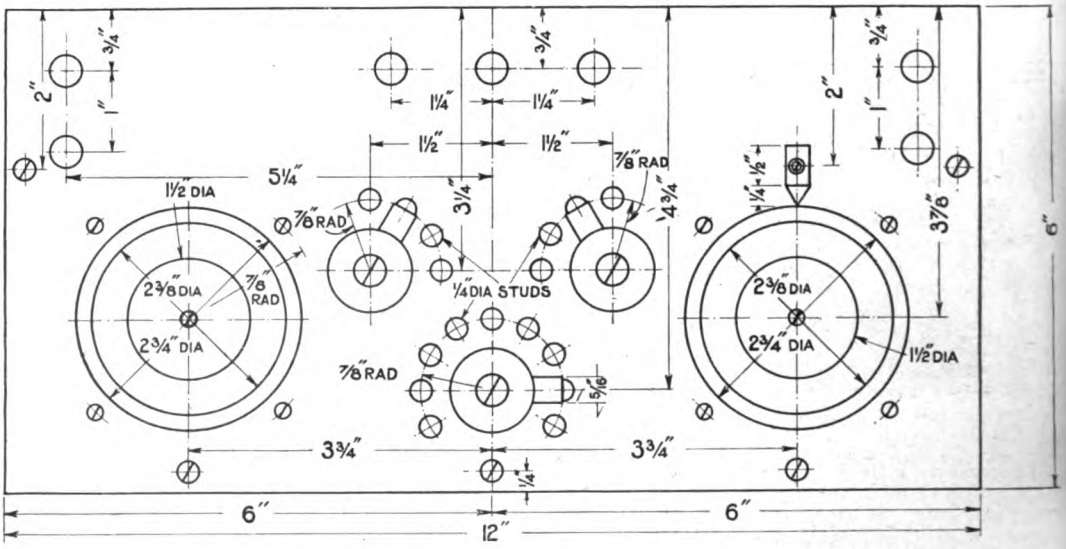
circuit, and 85 in the grid on a former 3½ ins. in diameter, and this tunes from 550 metres to about 1,200. In general ⅓ of the coil should be between A and F, and ⅔ between F and G.

To the right of the tuner in the photograph will be seen a little detector panel designed by the writer to go with the Reinartz tuner. The terminals are arranged in a convenient way, and the panel carries behind it a combined condenser and grid leak (0·0003 and 2 megohms), a filament rheostat, the choke above referred to, and the necessary terminals for H.T., L.T., and output. All leads are made as short as possible and the connections are made as in the diagram. The valve used is a QX, which suits this work very well.

The operation of the tuner is a little peculiar at first, and "wants knowing." As a beginning it is well to practise with a wavemeter such as the adjustment for telephony. On 300 metres there will be found steady increase of regeneration up to the oscillating point over about 30 or 40 degrees of the reaction condenser. Even on 180 metres there is no difficulty in setting at a critical value just prior to oscillation. For damped waves there is no capacity effect worth mentioning from the presence of the hand, provided the rotary plates of the grid condenser are connected to earth and the rotary plates of the reaction condenser to the aerial.

For short-wave C.W. reception it is well to fit the grid condenser with a short extension handle (3 ins. is long enough), or the capacity effect of the hand will be felt. Testing with a separate heterodyne on the other side of the room, oscillating at 130 metres, it was found possible to pick up the signal and *stop on the note required*, final adjustment




*Constructional details for front panel.*

Townsend, buzzing on various short wavelengths. The aerial switch should be tried at various positions, the grid switch set to include all the grid turns and the reaction condenser set about midway between maximum and zero. Before troubling to tune, try by tapping the grid terminal, whether the set is oscillating. If not, try various combinations of reaction condenser and plate turns until loud clicks, when the terminal is touched *and when the finger is removed*, show that the oscillatory stage has been reached. It will then be found that by varying the condenser one way or the other the set can be put just off oscillation, and, if the grid circuit is varied the signals from the wavemeter will be easily picked up. Readjustment of the reaction condenser and a few further trials will reveal a delightfully smooth and easy control of regeneration, with practically no backlash and perfect ease of of the note being made on the reaction condenser, which also controls the degree of oscillation. It is a noteworthy point that the fineness of control of the oscillation effectively prevents excessive re-radiation, which in most autodyne shortwave receivers is a great nuisance. In this case the oscillation of the receiver is adjusted to be only strong enough to give good signals. Of course, a separate heterodyne should always be used where possible.

The photographs and diagrams will tell the experienced man how to construct the Reinartz tuner. The beginner is advised to buy a sheet of ebonite of the measurements given, and $\frac{5}{16}$ in. thick. Three switches, with in all 17 switchpoints will be needed, and seven terminals. The empty Mark III. former is also obtainable from dealers. The baseboard is 12 ins. long, 5 ins. broad, and ¼ in. thick, and to this the panel is secured by two

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uprights, which may take any convenient shape. The condensers are the most expensive item, and should preferably be bought *for panel mounting.*

When the switches and their studs have been fitted and the terminals and condensers mounted in place, the panel should be secured to the uprights. Next, with the aid of insulating tubing, wire up those terminals and studs which are not connected with the coil. Then, to each of the terminals and studs which have to be connected to the coil, secure a separate length of about 9 ins. of insulated wire.

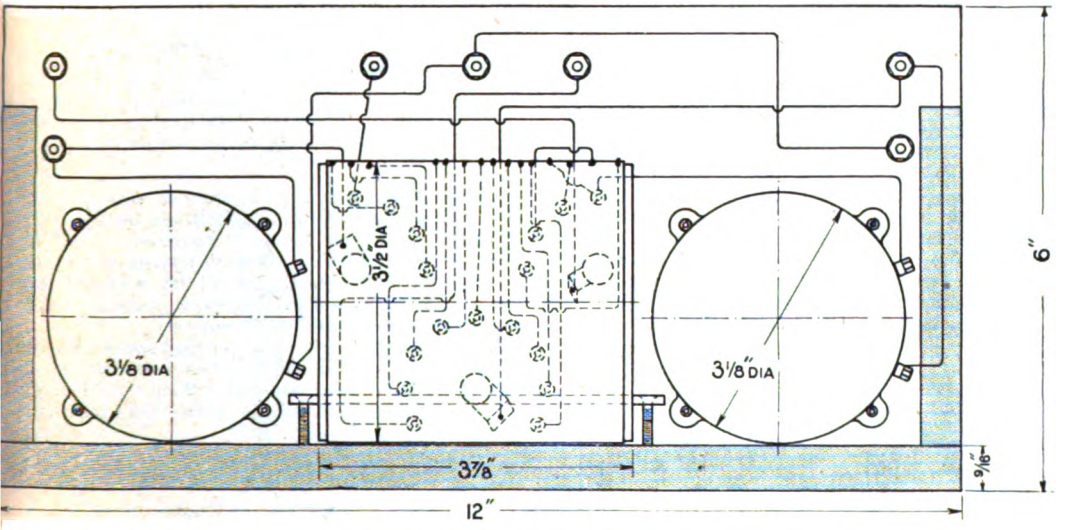
The coil should then be wound. At the extremity of the former drill a fine hole and pass the wire through it, allowing about an inch for connection. Then wind ten turns on the former and tap off. Continue for another ten turns and make a second tapping. A further ten turns are then wound and the coil cut after allowing an inch or so for the connection at the beginning. This completes the plate coil.

Starting again, with sufficient wire for linking up, wind two turns, then tap; two more, tap again, and then tap at the fifth, sixth, seventh, eighth, ninth and tenth turns. This completes the aerial circuit. Taps are then taken from the 24th, 30th and last (36th) turns for the grid switch.

In the tuner constructed by the writer, the taps were made by baring a short length of the wire, looping it and twisting it on itself before continuing the winding. Thus every tapping is a slight protrusion from the coil. They should all come on the top of the coil when this is laid in place. A strip of wood an inch broad and 5 ins. long serves to secure the former in a horizontal position, by the aid of two brass screws which attach the projecting portions to the baseboard.

The coil should be placed in position with the final turns on the left-hand side. To wire up, take the wire from the bottom stud of the plate switch, bare its end and twist it round the wire protruding through the former at the beginning of the coil. Take the second stud and similarly connect it to the first tapping, and so on as shown in the diagram. The tenth turn is taken to the central filament terminal, which is earthed. The final turn comes to the second grid stud from the top, the first being connected to the grid terminal above it.

When all wires have been joined in this way the joints should be carefully soldered. It is preferable, before joining up, to slip lengths of insulating tubing over all wires, but this is not necessary if good insulated wiring is used. Bare wire may be used on the former, but if this is the case, care must be taken that the joints do not short-circuit the turns adjacent. Strips of empire cloth or other insulation will prevent this.




*Constructional details (back view.)*

The tuner and its circuit would seem to open up wide possibilities for experimentation. There is no question as to its effectiveness for the work for which it is designed. The Editor will, I am sure, be very glad to publish experiences of other amateurs with this interesting invention.

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This article, though based upon American practice, opens up a new field of research in methods of reception, particularly for short wave signals. The Editor will welcome for publication descriptions of other circuits or apparatus designed specially for short wave work, and would be glad to receive also accounts of the experiences of readers with this particular circuit.

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# On Heterodynes

By PHILIP R. COURSEY, B.Sc., F. Inst.P., A.M.I.E.E.

(*Continued from p.* 163.)

OF the parts required to build up the instrument of which an outline was given in the first part of this article, the valve holder will first be considered. Although it is easily possible to build up an instrument of this type to operate with almost any type of valve, it is not always possible to obtain stable oscillations over the whole tuning range. The values here given are suitable for the average V 24 valve, so that a valve of this type should be used with them. To build up a holder for the valve, four clips will be required—one of them preferably being stiff, and the others thin and springy, so as to make good contact with the valve terminal caps. Suitable dimensions for the stiff or rigid contact are shown in Fig. 4. This should be bent up from 3/32 in. brass strip ½ in. wide. It may be fixed in the position shown in Fig. 2 (which is reprinted herewith for convenience in reference) by two 5 B.A. round-headed brass screws. The two side clips should be cut from thin springy phosphor-bronze strip, and are also ½ in. in width. Their dimensions are given in Fig. 5. The thickness of the bronze should not be more than about 1/64 in. The remaining end clip should also be ½ in. wide, and bent up from the same phosphor-bronze. Its dimensions are set out in Fig. 6. The larger hole shown at the left-hand end of the base strip of this clip is designed to be clamped under the LT – terminal of the instrument as was indicated on Fig. 2 in the first part of this article. The relative positions in which the four clips should be fixed can also be seen from that diagram, and from Fig. 7 which is a side elevation of the assembled valve holder.

The sockets for the coils should preferably be purchased ready made, and mounted on the instrument top in the positions set out in Fig. 2. By securing these plug sockets to the ebonite top by two screws into the brass portions, these screws can also serve for making the connections inside the instrument.

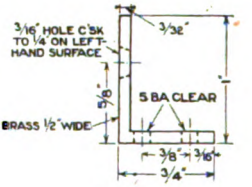


*Fig.* 4.

It should be pointed out that in this diagram, Fig. 2, the upper coil plug socket has been lettered "Main" and the lower "Reaction." If this lettering is adhered to, the connections to the plug sockets shown in Fig. 3 should be reversed, *i.e.*, the two leads joined to the lower socket should go to the upper one, and *vice versa*.

This rearrangement puts the coil socket labelled "Reaction" in Fig. 2 in series with the Anode circuit of the valve, and the "Main" coil in the grid circuit, in accordance with the schematic diagram in Fig. 1 (*see* p. 162).

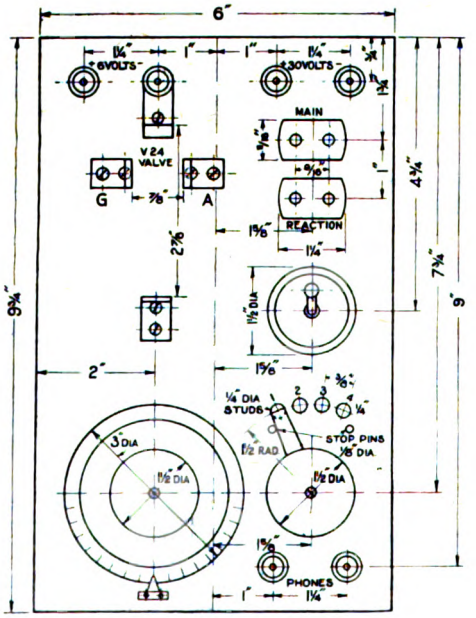


*Fig.* 2.

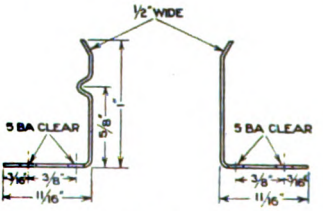


*Fig.* 5.

Any convenient form of switch can be used for the valve filament circuit. A miniature tumbler switch is shown on the plan of the instrument in Fig. 2, as a switch of this type is convenient for the purpose.

Unless a telephone transformer is fitted into the instrument, it is necessary to provide a link to short-circuit the terminals marked "Phones," when no telephones are required for use with the instrument. If a telephone transformer is fitted inside the case with the low-resistance winding joined to the "phone" terminals, such a link is not necessary when the telephones are removed. In case it is required, its dimensions are set out in

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Fig. 8. It should be cut from brass strip, ⅜ in. wide by 3/32 in. thick.

The essential dimensions of the 4-point range switch shown near the lower right-hand corner of Fig. 2, can be obtained from that diagram.

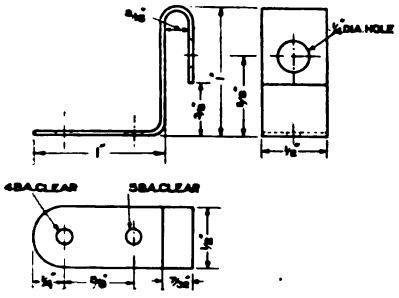


*Fig.* 6.

Both the switch arm—which should have three or four laminations—and the contact studs can be purchased ready for mounting, but if preferred they can be built up on the lines indicated in Fig. 9. and to the dimensions there given.

article, it will be noted that a condenser shunted by a resistance is shown in the connection to the grid terminal of the valve holder. While the valve is perfectly well able to oscillate without this

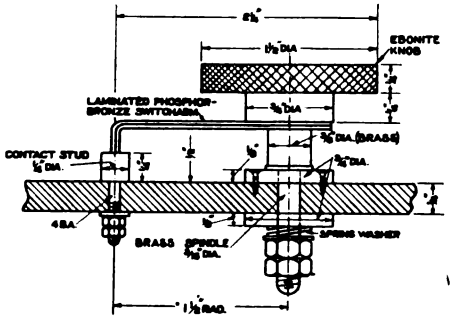


*Fig.* 9.

addition, its use is advantageous when using the instrument with telephones to indicate the approximate wavelength of an oscillating circuit, as it helps the valve to function better as a detector.

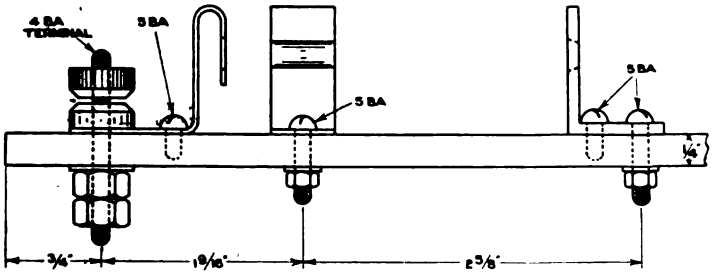


*Fig.* 7.

The variable tuning condenser shown near the lower left-hand corner of Fig. 2, should have a standard dial 3 ins. diameter, and should preferably be obtained ready made. Its maximum capacity should be about 0·0013 microfarads, and it should, of course, have air dielectric. Those who prefer to build their own condenser will find general instructions in earlier articles in these columns.

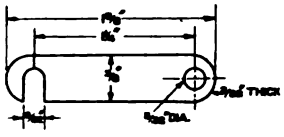

*Fig.* 8.

The pointer for the condenser scale can be cut from thin brass or bronze to the dimensions given in Fig. 10.

Referring again to Fig. 3 in the first part of this

The passage of the oscillating p.d.'s through this condenser also causes it to become charged and thus to make the grid potential more negative—a state in which the stability of the oscillations is often improved. It also exercises another effect—viz., to preserve a greater constancy of the frequency

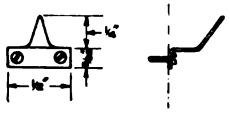

*Fig.* 10.

of the oscillations. It is well known that the apparent capacity of the grid electrode of the valve to the filament and plate is not quite independent of the filament temperature and plate potential, and that consequently any changes in these quantities will vary the effective capacity of the oscillation circuit—since the grid capacity is

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additive to the circuit capacity—and consequently vary its frequency. When a condenser is joined in series with the grid circuit it partly obscures this change, and lessens the effect which a change of grid capacity will produce upon the oscillation frequency. The resistance is, of course, necessary, to provide a leakage path for the grid currents, after the usual manner of using a grid condenser and leak.

The effect of this series condenser in rendering more constant the oscillation frequency will be greater the smaller its capacity is made in proportion to the grid capacity of the valve itself, so that the value of this condenser should be kept down as much as possible consistent with not stopping the oscillations set up by the valve.

On the longer wavelength ranges using the larger values of tuning condenser, the effect of variations of the grid capacity upon the frequency of the oscillations becomes less important as these variations are then swamped by the large capacity with which they are in parallel.

In order to meet these somewhat conflicting requirements, the values of this series condenser and resistance may be made similar to the values ordinarily used for grid condensers and leaks, or say about 0·0002 $\mu$F and to 2 MΩ; although tests show that for most ordinary purposes this condenser and leak resistance may be omitted and the lead from the condensers taken direct to the grid terminal of the valve.

If exact constancy of oscillation frequency is not required—such as in ordinary heterodyne reception—this condenser and resistance can be omitted from the circuit. If they are used, they can conveniently be mounted on the underside of the instrument top, immediately beneath the valve holder so that they are in a convenient position for connection to the grid terminal.

Three fixed condensers are required in the instrument of values 0·00125, 0·0025, and 0·00375 microfarad respectively. Convenient units made up to the capacity desired can be obtained and mounted inside the instrument as near as possible to the 4-point switch to which they are connected, so as to keep the length of the connecting wires as short as possible.

If it is desired to use an ordinary French, or R valve with an instrument of this type in place of the V 24 valve, for which it is designed, a few modifications are necessary. Firstly, of course, an R valve holder must be fitted in place of the one described. This can be mounted in the place occupied by the V 24 valve holder in Fig. 2, or preferably, from the point of view of spacing between the parts, etc., in the position set out in Fig. 11, which also shows the plug sockets for the coils in a fresh position. The location of all the other parts remains as set out in Fig. 2. This arrangement, Fig. 11, should give ample clearance for any ordinary type of valve to be inserted in the valve holder.

Using an average R or R 4 B valve, with 30 volts in the plate circuit, good oscillations can be obtained with capacities up to about 0·0025 $\mu$F in the tuning circuits. This maximum value is most conveniently obtained in four stages, with a variable condenser having a maximum of 0·0005 $\mu$F (or rather more) and four fixed condensers of 0·0005, 0·0010, 0·0015, and 0·0020$\mu$F respectively, which can be connected successively in parallel with the variable condenser. For this purpose an extra stud will be required on the range switch, making a total of five in all. This addition is also shown in Fig. 11.

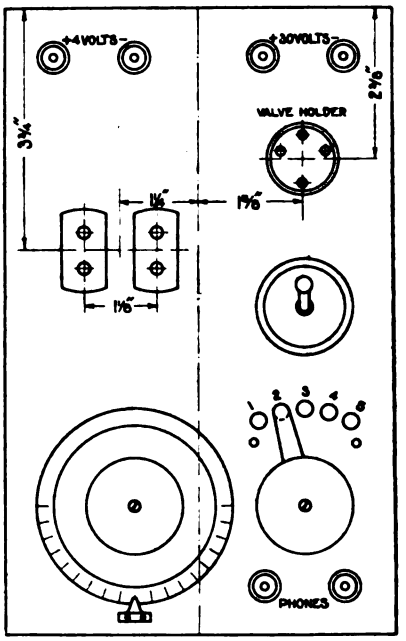


*Fig.* 11.

To cover the same range of wavelengths as was obtainable with the previously described arrangement, an alteration of the coil numbers required is necessary. To cover the same range of wavelengths with the above-mentioned maximum capacity it is necessary to use five coils instead of four. The combinations shown in Table III. give good results and stable oscillations over the required capacity range.

TABLE III.

Coil combinations for maximum capacity of 0·0025 $\mu$F.

| Main Coil No. | Reaction Coil No. | Approximate Wavelength Range (metres). |
|---|---|---|
| 50 | 150 | 250—1,100 |
| 200 | 150 | 1,000—4,400 |
| 400 | 200 | 2,000—9,200 |
| 1,000 | 400 | 6,000—30,000 |

As was mentioned in the first part of this article, a fixed filament resistance should be fitted inside the instrument. When the V 24 valve is fitted this resistance should have a value of 1 to 1½ ohms, so

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as to give about 5 volts (or just over) on the terminals of the valve filament when a 6-volt accumulator is joined to the LT terminals. The necessary resistance can be obtained by winding a few inches of resistance wire on a former composed of slate pencil, or a flat strip of micanite about $\frac{1}{2}$ in. to $\frac{3}{4}$ in. wide. If No. 30 S.W.G. Eureka resistance wire is used a length of from 6 to 8 ins. will be required. The resistance when completed should be mounted on the underside of the top of the instrument in any convenient position in the filament circuit, preferably supported so that the resistance wire is not in contact with ebonite top, or with other parts of the instrument.

With the instrument for the R valve, if a four-volt battery is used for the LT source in place of the 6-volt used with the V-24 valve, no filament resistance will be required. The LT terminals should in this case be engraved "4 volts," as indicated in the plan (Fig. 11).

The variable condenser in this case, although of smaller maximum value (0·00055 $\mu$F), can be of the same type as the larger one in the first-described instrument, and should be fitted with a 3 in. dial. Variable condensers of the type used in various patterns of wireless instruments used in the Services can be employed in both instruments.

*(To be continued.)*

# A Vernier Condenser

HERE is a method for making a very satisfactory fine tuning condenser. A cylindrical lamp glass is required of the type used for surrounding a vertical gas mantle. A rectangular sheet of tin foil is fixed by means of shellac varnish to the outside of the glass leaving about 1 in. spare at each end and extending half way round. The lamp glass acts as the dielectric and at the same time serves as a bearing for an internal revolving wooden cylinder which carries the inner plate. The cylinder is made of hard wood and is

*Fig.* 1.

an easy fit in the glass. It is covered on nearly half its circumference with very thin copper or aluminium foil, or if this is not available, tin foil may be used. The cylinder is given several coats of shellac varnish and thoroughly dried out before fixing the metal foil, and it will then be found that if a good deposit of shellac has been obtained that the foil can be fixed in position quite easily with a further coat of varnish. This inner plate of the condenser is not made exactly rectangular, but one on the longer edges is cut away to the shape shown in Fig. 2. This is necessary in order that the condenser may give a steady increase in value when operated near its minimum position. If it is not intended to calibrate the condenser when finished, and the revolving cylinder is a good sliding fit in the lamp glass, there is no need to provide bearings and an ebonite knob fixed on to one end will serve for making adjustment. If a pointer and scale are required it is then better to arrange bearings by carefully plugging the ends of the glass with wooden discs having holes in their centres to carry the brass spindle that passes through the centre of the cylinder as shown in the diagram. Owing to the risk of breaking the glass when plugging the ends an alternative method is to fix the cylinder down to a base board by means of two thin brass straps passing over it and setting up external bearings made out of small pieces of

*Fig.* 2.

sheet ebonite. Contact to the outer plate can be made by a piece of wire tied round at one end. When the brass strap is used a terminal can be adopted for holding down one end of the strap. Connection is made to the inner plate through one end of the spindle, and a strip of foil between spindle and inner plate establishes contact.

Such a condenser as well as being easy and cheap to make, possesses in its design, the great advantage of having perfect insulation, and so readily lends itself to fine adjustment when moving from zero.

*The photograph shows a neat amateur station erected by Mr. A. W. Ford of the Birmingham Experimental Wireless Club.*

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# Four-Electrode Valves and Their Circuits*

By Capt. H. DE A. DONISTHORPE.

**Capt. H. de A. Donisthorpe.**

FIRST of all I must apologise for my inability to attend this Society last month, when I was to have delivered my lecture on the "Harnessing of Electrons," but owing to pressing business, I was unavoidably absent from town.

In view of the fact that the discourse so ably given by my colleague, Mr. Blake, covered a large amount of the ground which I had intended to traverse, it is my intention this evening to talk to you on the last subject dealt with in my aforementioned lecture, and to open a discussion on four-electrode valves and their circuits.

In that lecture I dealt with the evolution of the thermionic valve from the first principles of the electron theory, illustrating in each of the various cases, and leading up finally to the four-electrode valve where a more or less complex control of electrons is brought about. Perhaps it would not be out of place at this stage to suggest the name of "Quadrode" for the four-electrode valve, in order to avoid the cumbersome expression at present in use.

From time to time we have listened to many interesting papers given before this Society, wherein the thermionic triode, or three-electrode valve, has played a prominent part; but, with the exception of that valued paper given by Prof. Fleming on December 10th, 1920, we have heard very little about the quadrode and its attendant circuits. I will therefore briefly deal with the various forms of such valves, and their corresponding circuits, and trust that those members who have had experience in this direction will contribute to the discussion, by giving their experiences, as I see we have one or two members here to-night who are intimate with their action and circuits.

To the absolute amateur, this discussion may not be of immediate interest, but it is hoped that he will be able to gain a certain amount of knowledge, so that, when these valves become a more marketable and cheaper article, he will have some groundwork to work on, in their manipulation.

The classification of the different types of quadrodes now in existence is not an easy matter, as each individual valve may be said to have been evolved for some particular purpose, that is to say, some are utilised for the purpose of rectification only, and others for magnification of radio signals, while others are designed for the reception of continuous waves. Roughly, they may be classified into three different types: –

*Type I.*—Those having two grids in addition to the usual filament and anode.

*Type II.*—Those having two anodes in addition to the usual filament and grid.

*Type III.*—Those having three anodes in addition to the usual filament.

In each of the above-mentioned classes it may be taken as a general rule that there are two controlling elements. These may be either two grids or two anodes, as we know them with regard to triodes; the electrodes of quadrodes having at the present moment no standardised nomenclature.

It will be noted that this classification only relegates these quadrodes into different groups according to the electrodes actually employed, and therefore no useful purpose will be served by dealing with them according to this classification. I will, therefore, as far as possible, deal with the subject from a chronological point of view.

The establishment of a thermionic current between the hot cathode and the anode of a triode is now a well-known fact, and the electrons in this instance may be said to be controlled by means of a static charge impressed on a grid inserted in their path. In the case of quadrodes, however, the electrons do not experience such a quiet journey in the functioning of the valve; and, in the different types of such valves, the electrons are affected in different ways, by reason of the additional electrode. In some cases there is a diversion of electrons from one main anode to an additional one, and in others the electrons are made to overstep their mark on reaching a highly positive grid, with the result that they pass through it to the further electrode, the resulting additional work so evolved being beneficially employed. Or, again, the electrons may be buffeted about between two electrodes during their journey to the anode.

Perhaps the original quadrode was that due to Majorana, which was patented in 1912. The circuit in which this was used, and the general arrangement of the electrodes of the valve, are shown in Fig. 1. This valve was designed for the purpose of rectifying

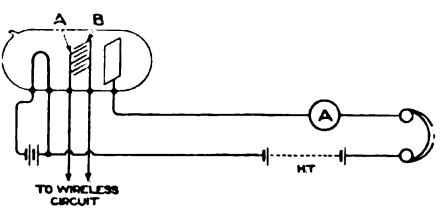


*Fig.* 1.

radio signals, but the results obtained therefrom can only be compared as equal to that produced by ordinary crystal rectification. From the figure it will be seen that the grid is split up into two separate and insulated portions, A and B, which may be compared to two separate grids, and the P.D. to be detected is connected across these two portions. In this connection it should be pointed out that the potentials on these two grids should be equally above and below that of the filament. Now, when an alternating P.D. is applied to these two halves, the electrons may be said to be buffeted about,

* A Discussion before the Wireless Society of London, opened by Captain H. de A. Donisthorpe, on Wednesday, April 26th, 1922.

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with a resulting reduction in anode current, and a corresponding variation of current in the anode or telephone circuit; so that incoming radio signals applied to these two grids are consequently rectified.

In view of the fact that this is a potential-operated device, it will be seen that it is necessary to use a large inductance across the two grids, in order to obtain the maximum sensitiveness, and, consequently, it is more sensitive when employed for the reception of long waves.

Prof. Fleming perhaps made the next step, in the introduction of his type of four-electrode valve, and, as mentioned before, a full description was given by him before this Society, so that I will not do more than briefly describe the valve and circuit he uses.

The action of this valve is very similar to that aforementioned, due to Majorana, and the valve consists of four plates, which are curved along their axes, so that their convex surfaces are towards the filament, the filament being a short straight vertical one, made of tungsten, and situated in the middle of the four plates. One pair of diametrically opposite plates is connected together, and forms the anode or collecting plate. The other two are the two control elements, and may be compared to the two grids in the Majorana valve. Prof. Fleming has called these plates the potential plates. The circuit in which this is employed is shown in Fig. 2, where it will again be seen that the two controlling elements are connected directly across the receiving circuit.

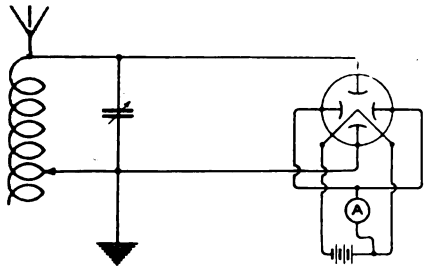


*Fig.* 2.

When the valve is in action the usual anode-filament current is established, and an incoming signal, induced from the aerial into the secondary circuit A, produces a difference of potential across the ends of the inductance of that circuit, with a consequent P.D. between the plates $A_3$ and $A_4$, with the result that there is a decrease in the anode-filament current. The characteristic curve, illustrating the action of this valve, is shown in Fig. 3, from which it will be seen that a potential difference on the potential plates produces a fall in the thermionic current from the filament to the collecting plates. It will be clearly seen that the extent of this decrease is determined by the potential difference applied to the plates, so that the results obtained are proportionate to the amplitude of the radio signals taking place in the wireless circuit.

It will be noticed in the above two cases that there is one very marked difference, and that is that the former type embodies the two controlling electrodes directly in the electronic stream whilst in the latter this is not so. This is shown in the two diagrams on the board (*one a sketch of Dr. Fleming's four-electrode valve and the other with filament, two grids and plate in succession*).

There are two other similar forms of quadrodes, due to Mr. Hesketh and Mr. Scott-Taggart respectively. The latter uses an identical circuit to that employed by Prof. Fleming, but employs a grid leak to allow the negative charges to leak away from the control elements or potential plates.

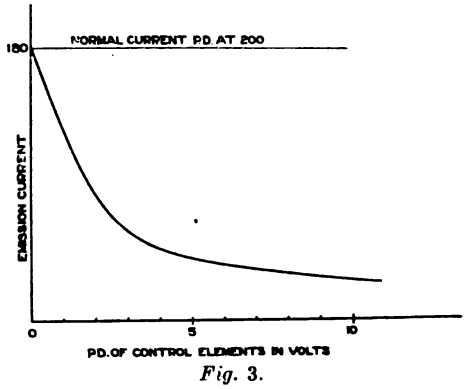


*Fig.* 3.

The above-mentioned forms are of interest from an historic point of view, in that they mark another step in the progress of the thermionic valve practice in radiotelegraphy and radiotelephony, but cannot be said to be instruments of great practical value, in view of the fact that their uses and sensitiveness are not superior to those of existing methods of rectifying and amplifying.

The next types which I intend to describe, however, are of interest from the fact that they are a considerable improvement over existing types of triodes, inasmuch as they function in such a manner that one of these valves will do the work of two or three triodes, or will allow C.W. reception other than by the existing known methods.

There are several well-known types of quadrodes, the first being known as the Marconi Four-Electrode Valve, the next two being due to Mr. Scott-Taggart, and the last a German pattern which I have drawn up on the board here (*filament, grids and plate in succession*). This is the usual Telefunken bulb, and a glass support which holds the outer electrode and the two grids and the filament and the connections coming through. Germans are very good glassworkers and make a satisfactory job of this type of valve.

The three first mentioned are now commercial articles, and are used in the Marine Radiotelegraphic Service. In view of the fact that Mr. Scott-Taggart is here, and will I hope give us a description of his valves and circuits, I will not dwell on these two forms but will now describe the Marconi quadrode and its attendant circuits, whereby may be obtained, with one valve, a one-stage H.F. amplification, rectification, and a one-stage L.F. amplification.

In appearance this valve is very similar to the familiar "Q" type, but slightly larger in external dimensions, and possesses, in addition to the usual mesh grid, an additional grid of a spiral form.

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The electrodes are known as the "first grid," "second grid," and "outer electrode," and connections are made by means of metal pips on the outside of the glass.

Fig. 4 shows you roughly the general construction of these valves, showing the spiral grid and the mesh grid, and the outer electrode.

The next illustration (Fig. 5) shows a simplified

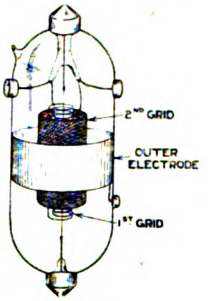


*Fig.* 4.

diagram of connections, when using this quadrode for the purpose of rectification. It will be seen that the connections of the second grid, are similar to those of the anode circuit for a triode arrangement, the high-tension battery being connected in this circuit for the purpose of attracting the negative electrons given off from the filament.

This second grid, in fact, functions similarly to that of an anode of a triode, but since it has the construction of a grid, the electrons on reaching it pass through due to the velocity they have attained on their journey from the filament.

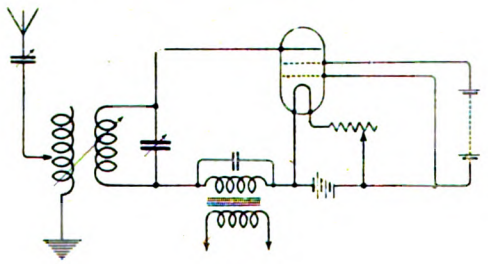

*Fig.* 5.

Now the outer electrode is connected to the negative end of the filament, consequently, the electrons on passing through the second grid, come under the influence of a negative charge and are retarded.

A drop in volts across the second grid and outer plate results, which, it will readily be seen, is equal to the rise in volts between the filament and first grid, therefore the speed of the electron at the outer plate will be equal to its speed at the filament, which is zero.

If an alternating E.M.F., due to induced oscillations from radio signals in the wireless circuit is applied across the outer electrode and negative end of the filament, as shown in the diagram, the positive halves of the oscillations will cause the electrons to be attracted, and during the negative halves repelled. A rectified current will therefore flow in the outer electrode circuit in series with which is a telephone transformer.

The foregoing illustrates the manner in which the quadrode can be made to operate as a rectifier, but with the aid of the circuit shown in Fig. 6, a one-step high-frequency amplification is obtained in addition.

Referring back once again to the action of the triode, it is well known that by carefully adjusting the potential of the grid relative to the filament, a current can be produced in the anode circuit of greater magnitude than that of the induced current of the radio signals flowing in the grid circuit.

It has already been pointed out that the second grid of the quadrode takes the place of the anode in the triode, so that the magnified current due to the radio signals in the wireless circuit is produced in the circuit of the second grid. In this circuit a primary winding A of a high-frequency type of transformer is connected, the secondary B of which is in the outer electrode circuit.

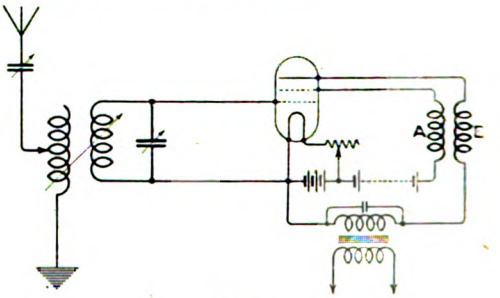


*Fig.* 6.

It follows that the oscillations of this magnified current in the second grid circuit produces an alternating E.M.F. across the secondary B. This secondary is connected across the outer electrode and negative end of the filament, consequently the magnified current is duly rectified, and thus a one-step high-frequency amplifier and rectifier is satisfactorily obtained.

A still further stage can be accomplished by means of one of these quadrodes, whereby the low-frequency oscillations obtained in the outer grid circuit of the previous arrangement can themselves be amplified. The circuit for attaining these results is shown in Fig. 7. Here the rectified signals are impressed back on to the first grid by means of an iron core transformer, whose ratio of windings is 1/1, and a simple low-frequency triode arrangement follows, the low-frequency amplification being produced in the second grid circuit in the usual manner, in which circuit the telephone transformer is connected.

These two transformers, are shunted by two small blocking condensers in order to allow the high-frequency currents flowing in those circuits to pass freely. Thus a one-step high-frequency magnification, rectification, and a low-frequency magnification is successfully obtained with the use of one valve.

Another use of this instrument is the elimination of jamming. By means of the potentiometer the plate potential may be varied over the whole range

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of the characteristic curve, so that any point on this curve may be selected at will.

Rectification occurs at either of the bends A or

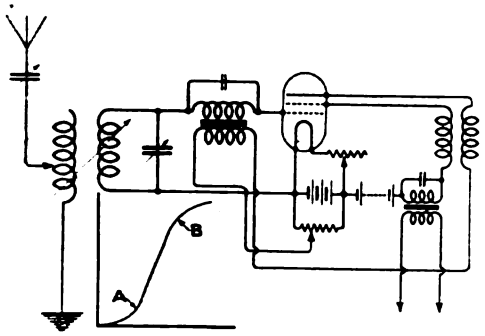


*Fig. 7.*

B, but as the two effects are in opposition there will be a point, near the centre of the straight part of the curve, at which the resultant rectification is zero and the signal becomes inaudible. The position of the vanishing point so obtained will be found to differ according to the quality and strength of the received signal, hence it is possible, in most cases, to so adjust the potentiometer that a jamming station is entirely cut out, while the required signals remain audible.

I have here on the table an instrument which I have just been speaking about. This is the quadrode amplifier, the potentiometer, filament resistance and a switch for varying the high frequency transformer windings. It will be seen that the last-named arrangement provides for a variation of the number of turns in the transformer so that it is possible to obtain windings corresponding to a wavelength of 300, 600 or 800 metres. Unfortunately, the tuner I am using in conjunction with this amplifier will not go down to 600 metres, in view of the long aerial we have got here, so that I am unable to demonstrate this amplifier very satisfactorily. I thought when I came here the aerial was an ordinary "Postmaster-General's" amateur type of aerial, but it is considerably longer. However, if any of you like to come up afterwards you can test the apparatus for yourself.

The question of inserting further electrodes into the bulb of a thermionic valve, in addition to those of the quadrode, has already been considered. In this connection, however, it should be borne in mind that with each additional electrode the construction of the valve becomes more difficult. A circuit devised by Capt. Round, wherein a valve containing three grids, $G_1$, $G_2$, and $G_3$, and one plate, P, is employed, is shown on the board (Fig. 8). Here the incoming high frequency oscillations in the circuit A are impressed by means of the usual high frequency type of transformer T, between $G_1$ and the filament. Magnified current will flow in the circuit of the second grid, $G_2$, this grid serving as an anode. By means of the transformer $T_1$, magnified P.D. is impressed between the third grid, $G_3$, and the filament, so that a second magnification takes place in the actual plate circuit. The signals so obtained in the circuit S, by means of the H.F. transformer $T_2$, can then be suitably rectified.

There are numerous other ways of dealing with these additional electrodes, which I have not got time to go into now.

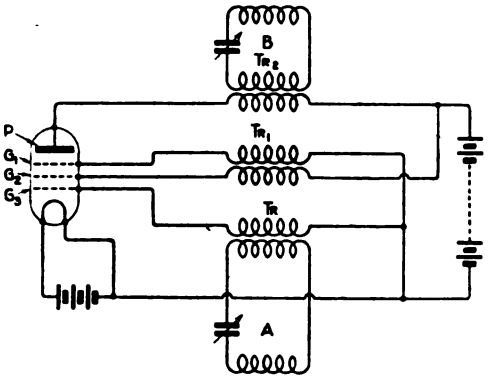


*Fig. 8.*

In conclusion, I would like to state that I personally have had experience only with the Marconi Four-Electrode type, and that the remainder of my paper must be taken as a collection of data, which I trust will have proved interesting; and I now hope that we shall have the pleasure of hearing some of our other members' experiences in connection with quadrodes.

*(To be continued.)*

# New Amateur Wavelength.

In a speech in the House of Commons on Thursday, May 4th, Sir Henry Norman made special reference to the position of the amateur wireless experimenter in this country. He said there was a large and enthusiastic body of scientific workers in this country who were keenly interested in amateur wireless. He estimated that there were at least 10,000 at the present time and that before long this number would probably reach 100,000. The decision of the Committee which the Postmaster-General had appointed, had now removed some of the restrictions on their operations. A new wavelength of 440 metres had been sanctioned for transmission and the wireless amateur was to be exempt from inspection of his receiving station and would no longer be restricted as to the length of receiving aerials.

Sir Henry Norman paid a tribute to the work of the amateurs and expressed the opinion that they deserved all the encouragement they could get. He referred to their services given during the war and emphasised the importance of this body in the event of any future crisis. It was also pointed out that there should not exist amongst amateur wireless workers any feeling that the public services were unsympathetic towards them. On the contrary the desire existed to give them all the freedom which was compatible with public interest.

Sir Henry Norman acted as Chairman of the Sub-Committee of the Imperial Communications Committee, which considered the question of wireless telephone broadcasting, and whose report formed the basis for the Postmaster-General's scheme.

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# A Change-Over Switch

By CYRIL J. MORLEY.

IN common with most amateur experimenters in Wireless Reception I have long realised the need of a quick and easy method of changing from one set of coils to another, and while trying various means of doing this was faced with the difficulty of obviating the dead end effects of the unused coils. To eliminate these effects this switch has been designed.

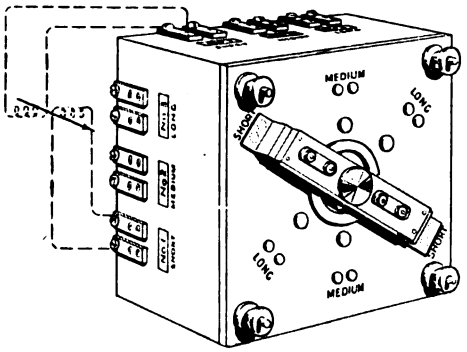


*Fig.* 1.

Being a user of the three types of coil—cylindrical, honeycomb, and basket wound—it was extremely desirable for purposes of comparison to be able to instantly change from one set to another without the undoing of terminals, etc., whereby valuable time is lost and comparison rendered impossible.

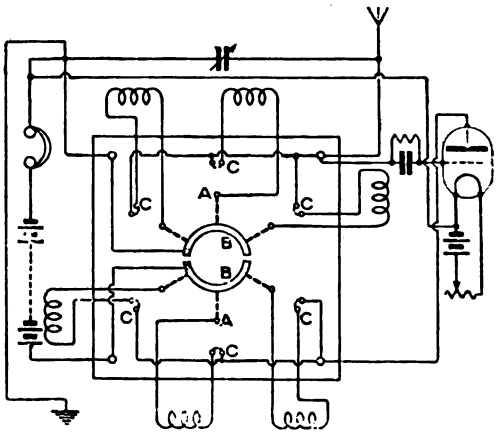


*Fig.* 3.

For variation of circuit I use a valve panel, described in *The Wireless World* and, in addition, the switch illustrated in Fig. 1 enables me to compare the results of various coils on the same wavelength.

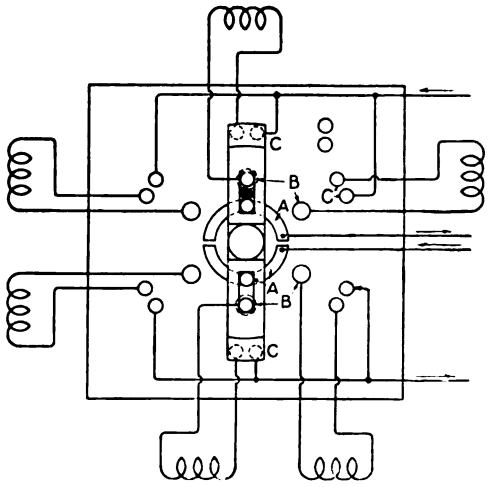


*Fig.* 2.

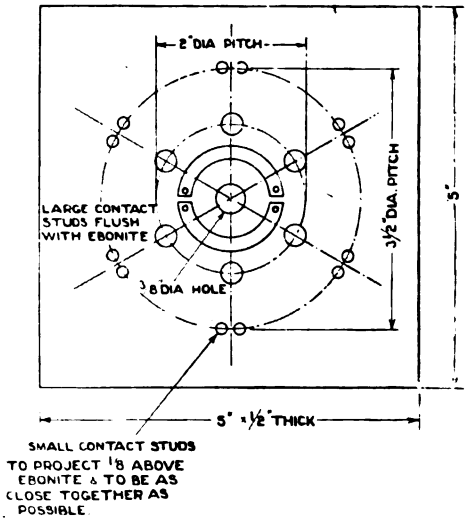
2" DIA PITCH
3½" DIA. PITCH
5"
LARGE CONTACT STUDS FLUSH WITH EBONITE
⅜ DIA HOLE
5" x ½" THICK
SMALL CONTACT STUDS TO PROJECT ⅛ ABOVE EBONITE & TO BE AS CLOSE TOGETHER AS POSSIBLE

*Fig.* 4.

It will be seen that with one movement of the

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switch arm any one of the three sets of coils can be brought into use instantly without having recourse to altering connections, and it is to be understood that this switch is not limited to three sets of coils but is suitable for any number, and should be of great use to the average amateur for, say, a long wave set, short wave set, and medium wave set, any of which can be brought into use immediately without having any dead end effect from the two sets not in use, or the switch may be used for comparison of different coils for same wavelength.

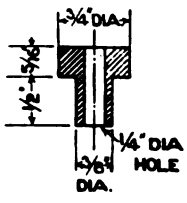


*Fig. 5.*

A diagram of the connections is given in Fig. 2, and on reference it will be seen that the switch comprises two circles of studs and two collector rings, contacts being made at A and B by spring contacts taken out of lamp holders, and at C by a piece of springy brass which short circuits two adjacent studs and completes the circuit for the particular coil in use. The switch arm is made of ebonite.

In Fig. 3 is given diagram of connections for ordinary reaction circuit using one valve only. The connections made by the switch arm are shown by the dotted lines, *i.e.*, from ring B to stud A, and from stud C to C, thus completing the circuit. The reaction coil circuit is completed in the same manner.

Full diagram of connections is given in Fig. 2, and it will be noticed that every coil is absolutely independent until connected by switch arm.

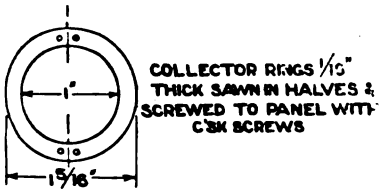


*Fig. 6.*

Full details for component parts are given herewith :—

1 Switch arm,
1 Centre bush,
1 Switch arm pivot,
18 Contact studs,
2 Collector rings,
1 Ebonite base.

Into the ebonite switch arm are screwed four spring contacts, A.A., these being connected at the top as shown at B. The contact for the outer ring of studs is made of 1/64" German silver, chosen because of its springiness.

To construct this switch, first get a panel of ebonite 5" × 5" × ¼" (Fig. 4). From the centre of this panel scribe a 3½" diameter circle and mark off the centre lines at every 60°. From the same centre scribe a 2" diameter circle. Drill a ¾" hole in centre and drive in centre bush (Fig. 5). Next fix the collector rings (Fig. 6), and fix contact studs on 2" circle. These must be countersunk in until they are flush with the ebonite. Then fix the outer ring of contact studs and face them all up level. This completes the Switch Panel.

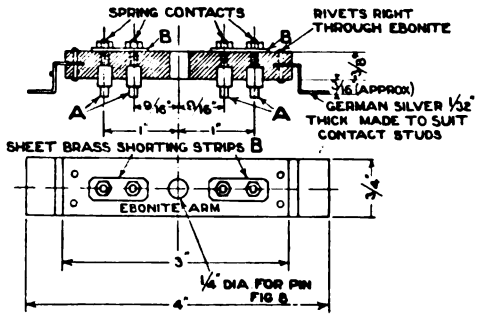


*Fig. 7.*

To make the Switch Arm, Fig. 7, take a piece of ebonite or fibre 3" long, ¾" wide, ¼" thick, drill a ¼" hole in the centre. Drive in the Switch Arm Pivot (Fig. 8), and then at 1" from the centre each way counterbore for and fix the spring contact A.

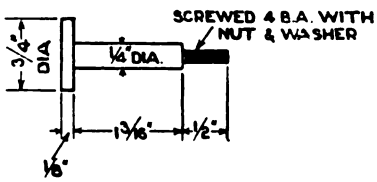


*Fig. 8.*

Then at 9/16" from the centre each way fix the spring contact B. The German silver contacts must now be fixed. Saw cut the ends of ebonite arm as shown, bend the German silver down until it makes a good contact and shorts the adjacent outer studs.

Fig. 1 is merely a suggested method of finishing the Switch.

## A PRIZE WINNING CIRCUIT.

The prize award offered by MESSRS. B. HESKETH for the best circuit used in the reception of the Transatlantic Tests, has been awarded after very careful investigation, to MR. H. H. WHITFIELD, who was also the winner of the second prize for reception of American signals.

A description of the circuit and apparatus used by Mr. Whitfield appeared on pp. 681-684 of the issue of *The Wireless World* for February 4th, 1922.

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# The Radiotelephone Broadcasting

THE announcement which has been so eagerly awaited regarding the facilities to be given for Radio Telephone Broadcasting has now been made by the Postmaster-General. In the House of Commons on Thursday afternoon, May 4th, Mr. Kellaway announced that the recommendations of the Wireless Sub-Committee of the Imperial Communications Committee, which had been appointed to consider the question of broadcasting, had been accepted, and the Postmaster-General then outlined the system which he had sanctioned.

This country is to be divided into areas and broadcasting stations will be located in each area, the following towns forming the centres :—London, Plymouth, Manchester, Glasgow or Edinburgh, Cardiff, Birmingham, Newcastle, and Aberdeen. One or more broadcasting stations will be allowed in each area.

Permission to conduct the broadcasting service will be given to British firms who are *bona fide* manufacturers of wireless apparatus and the Postmaster-General is calling together the representatives of the firms who have made application for this permission, in order that some system can be worked out which will be satisfactory to all concerned.

The limit of power for each broadcasting station is fixed at 1½ kW, and the wavelength is to be such that no interference will be caused with other services and transmissions in each particular area.

Times of broadcasting are fixed for 5 p.m. until 11 p.m. on weekdays with no restrictions as to time on Sundays.

A licence to install a wireless receiving set will cost 10s. and these licences will be obtainable through any Post Office.

So opens in this country a new field of communication, the ultimate future of which it is not yet possible to appreciate. We may, however, look forward to the time when it will be imperative, if one wishes to keep abreast of the times, to install a wireless receiving station at home, and those who do not take advantage of the facilities not offered will be depriving themselves, not only of the enjoyment which may be obtained in the home from listening to musical selections, concerts and so forth, but also any items of general information which may be broadcasted, including lectures and possibly sermons on Sundays. The exact character and classes of news which it will be permitted to transmit has not yet been decided upon by the Postmaster-General.

No doubt full consideration has been given by the authorities to the possibility of serious interference if the wireless telephone receiving sets supplied to the general public are of such a nature as to permit of radiation. This point is still more important when we consider that the vast majority of those who will be installing wireless telephone receivers in the near future will be ignorant of the most elementary points of wireless theory, and will operate their sets entirely by rule of thumb. It would seem desirable that in issuing permits for the reception of telephony, that the Postmaster-General should make a very marked distinction between permits for experimental wireless and permits for the installation of a set where the user merely desires to avail himself of the broadcasting service.

At the present time, when application is made for a licence to conduct experiments in wireless telegraphy, the applicant is required to satisfy the Postmaster-General as to his ability to handle the apparatus without causing interference by radiation.

It would seem necessary for the proper regulation of wireless in this country that the types of sets to be used in the reception of the broadcasted transmissions should be approved by the Post Office Authorities before being supplied to holders of licences. If these sets were "registered" as it were, at the Post Office, a sample set being submitted by the wireless firm supplying, the position of the *bona fide* experimenter would then be clearly defined and his liberty would not be interfered with. Perhaps, by making this distinction the Postmaster-General might see his way to giving even greater facilities to the *bona fide* experimenter than is the case at present.

In approving applications for permits to conduct the broadcasting service, the Postmaster-General has obviously a difficult task before him. It is essential that no firm should undertake lightly such a service, as the expense of maintaining the service will doubtless be considerable. The financial gain to the firms who undertake the broadcasting service will depend upon the number of receiving sets which they are able to sell. Obviously then it would be grossly unfair for any firm to undertake broadcasting, without giving full guarantees not only of their ability to maintain the service without interruption, and efficiently from a technical point of view, but also that the nature of the transmissions given would be maintained at a reasonable standard.

In his statement Mr. Kellaway made reference to what was being done in the United States in the matter of supplying Radio Telephony Broadcasting Services, and the point was mentioned that the United States Government had found it necessary to reconsider the whole question with a view to controlling the use of wireless, particularly in respect to amateur transmitting stations. As Mr. Kellaway added, "we in this country have been able to profit by the experience of the authorities in the United States and are in a position to legislate in such a way as to prevent any such state of chaos as was threatened in the United States." There, as is generally known, there are no restrictions as to the installation of receiving stations and transmitting licences have been very easily given in the past. Perhaps we might suggest that here again the experience of the United States authorities only serves to emphasise the necessity of distinguishing carefully between the *bona fide* experimenter and the general public.

No doubt there is a very great future for wireless in this country and to use the words of the Postmaster-General in his concluding remarks on the subject in the House of Commons, "the possibilities of this service are almost unlimited. In the United States of America it was suggested that some arrangement might be made by which speeches of

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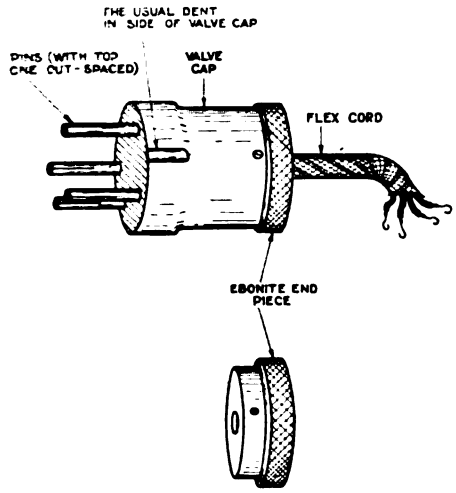
members of Congress might be radiated, and I can foresee a time when perhaps on this table a receiver will be properly concealed so as not to jar the æsthetic sense of members, and their eloquence will be transmitted to those of their constituents who are prepared to pay the cost."

The Broadcasting Service cannot but serve to foster still further the national spirit of our Island Kingdom, and will undoubtedly extend in the near future to all parts of the Empire.

# A Four-Way Plug

By V. D. BROOKER.

NO doubt everyone dealing with up-to-date "wireless" apparatus on which valves are employed, has at some time or other experienced the misfortune of either breaking a valve or of having it burnt out. The result being that the old broken valve is usually thrown away as being of no further use, and following is given a description where the same could be used in the making of an efficient non-reversible four-way plug. All that is required of the valve is the plug portion, therefore, first of all, the glass bulb and interior must be removed. When this has been done it will be noticed that left behind, is what might be termed a copper cup with an insulated base, in which are fixed the four pins of the valve. By the side or through the pins are four holes, where the wires from the plate, grid and filament of the valve were previously threaded through the insulated base, and soldered on to the pins. Next




is required two lengths of town main flexible twin wire, these being long enough to suit the requirements. The eight ends of this wire are then each bared for a distance of about ¼ inch and four of them are threaded through the holes in the old valve base and soldered to the four pins. On reaching this stage it has been found that melted sealing-wax, poured into the copper cup, will hold the four wires perfectly tight and also serve as an excellent insulator. Where several plugs might be required, different coloured sealing-wax could be used in each case, in order that the plugs may be distinguished one from the other and so avoid confusion. Where a little more elaborate finish might be required, these copper valve bases need not be filled right full with wax, but about ¼ of an inch from the top be allowed in order that an ebonite or wooden top may be fitted and secured through the sides by three screws (Fig. 1). When the sealing-wax is cold, the two lengths of flexible wire can be twisted together and the end bound, which will make a very neat four-way cord. The remaining four bared ends for connecting to the apparatus may be finished off with any form of wire grip or connection according to whichever is claimed to be the most suitable. On the receiver or other apparatus, as the case may be, an "R" valve socket can be fixed, and by means of this cheap home-made plug, any tuner, transformer (H.T. and L.T. together), and other apparatus can be connected quickly and without any fear of them becoming reversed.

One of these plugs has been constantly in use for twelve months and is now working well.

# Notes

### Death of Captain Carus-Wilson, M.C.

Captain Louis Charles Carus-Wilson, M.C., Assistant Experimental Officer at the S.E.E., Woolwich, has died at Brighton from illness contracted whilst on service in the near East.

In 1919 Captain Carus-Wilson was selected by the War Office to be the representative British officer at the Ecole Supérieure d'Electricité of Paris. There he won the diploma in radiotelegraphy, and was first on the list of foreign officers who completed the course. He was appointed to represent the War Office during the installation of the Cairo station.

### Short Wave Directional Wireless.

Important research has been carried on in connection with directional transmission on very short wavelengths and in a paper given before the Institution of Electrical Engineers on Wednesday, May 3rd, Mr. C. S. Franklin, an experimental engineer of Marconi's Wireless Telegraph Company, disclosed some hitherto unpublished information on this subject.

Employing a wavelength of only fifteen metres, duplex wireless telephony has been carried on between London and Birmingham, which has been audible only at the specially designed stations carrying on the experiments.

Another result of this research has been the evolution of a "wireless lighthouse," which may mean much for the safety of navigation. A wireless beam, radiated by a revolving transmitter, can be made to indicate to a ship its exact position with respect to the "wireless lighthouse."

The apparatus concerned was demonstrated with a transmitter using a wavelength of only one metre.

### The Dutch Concerts and Interference.

In our issue of April 8th, on page 52, reference was made to complaints of jamming of the Dutch Concerts by local amateur transmissions. Since the publication of this note we have received letters of strong protest from the Secretary of the Halifax Wireless Club and from Mr. H. H. T. Burbury

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These gentlemen rightly point out that with suitably selective tuning of receiving sets, interference should not be experienced from local experimental transmission on 1,000 metres, when the wavelength of the Dutch Concerts is 1,070 metres. The Secretary of the Halifax Wireless Club, who, by the bye, does not transmit, states that he listens regularly to the Dutch Concerts without any interference from local amateurs transmitting at the same time and located all round him.

**A Wireless Demonstration.**

Probably for the first time in history a wireless aerial was installed at a place of worship in this country on April 27th. This was done by permission of the Postmaster-General, to the Guildhouse, in Eccleston Square, S.W., for the purpose of demonstrations which accompanied a lecture on Wireless Telegraphy and Telephony, given there by Mr. A. O. Gibbon, of the Engineer-in-Chief's Office, G.P.O., in aid of the funds for the League of Arts.

Loud-speaking telephones and a new method of amplification being employed, the audience were enabled to hear various items of news, music and spoken verse transmitted from the various stations around London—a typical demonstration of "broadcasting," proposals for which are now approved by the authorities. During the evening a relayed telephone "radio" message was received from Hot Springs, Arkansas, U.S.A., and successfully received by the Burnham station at Chiswick and transmitted from thence to the audience at the Guildhouse—a message of greeting to the Chairman (Mr. Pomeroy Cragg) from Miss Maud Roydon. This was received with tremendous applause.

Mr. Harry Lauder then sang two songs, which were received with astonishing clearness.

The apparatus on view and in use included specimens of the G.P.O. instruments, Western Electric, Burndept Co., Ltd., S. G. Brown, Ltd., and others.

For a most successful evening thanks are due to Mr. A. O. Gibbon, Engineer, G.P.O., and Mr. E. J. N. Winstone, Chief Inspector, G.P.O., for the excellent manner in which everything was worked and explained.

**Broadcasting Wavelengths.**

Sir Henry Norman announces that the authorities have allotted the band of wavelengths from 350 to 425 metres for Broadcasting.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Whilst listening-in to-night at about 8.20 p.m. on a three-valve set, we picked up strong telephony on 800 metres. He was calling "ABC de XYZ," and gave us (*a*) a recitation of humorous poetry; (*b*) a song; (*c*) a gramophone record; (*d*) another record—"Swanee"; (*e*) another song. He then called "CQ" and promised further concerts on Tuesday evening, April 25th, at 8.30 p.m., and Friday evening, April 28th, at 8 p.m. on 800 ms.

If you can find space for this, readers who have not yet heard this may be glad to listen-in and perhaps someone can tell us who "XYZ" is. Perhaps XYZ himself would oblige. The signal strength here at Wolverhampton was considerably louder than **2MT**, but jamming from a harmonic of a French automatic C.W. station was appalling.

T. W. HIGGS.
A. C. H. BASSANO.

Dunstall House,
Wolverhampton.
*April* 20th, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The Committee of the Wireless Society of London has wisely recommended that the general use by amateurs of 1,000 metres should cease.

Pending the adoption of this recommendation, may I, as one of the many listeners to the Dutch concerts on Sunday afternoons implore the amateurs who have telephonic transmitting licences to moderate their exuberance at such times and, as they are strong, to be merciful.

Croydon, of course, is a recognised necessity and his official conversations with Lympne and various aeroplanes are always brief, terse and to the point, but even Croydon has occasionally to raise his stentorian voice to request silence on the part of some amateur who is jamming intercommunication with an aeroplane.

I hoped that Croydon's request last Sunday afternoon for cessation of transmission was addressed to an unknown individual in my neighbourhood who was carrying on an interminable conversation about nothing in particular with another experimenter whom he addressed as "er . . . old chap." Unfortunately for me it was some other transmitter who was interrupting Croydon.

My unknown neighbour complains frequently to "er . . . old chap" of the jamming of other amateurs in his locality but confesses that he keeps his P.O. telephone number secret, presumably to avoid complaints about his own transmission.

It is more than exasperating when listening to the Hague concert to have a fine rendering of "A Lover in Damascus" overpowered by a blatant cornet solo or chippy rag-time as performed on my unknown neighbour's gramophone.

I find it impossible to tune him out, and therefore infer that he must either be very near me or else abnormally strong.

W. H. MERRIMAN.

*Chiswick W.4.*
*April 24th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to the tests carried out by **2AW** and **2QK**, which I consider are very good, perhaps my experiences may interest them. Up to recently, about two weeks ago, I never used more than 0·01 amp. in the aerial on 1,000 λ, although I could use more. I was received O.K. about eight weeks ago in Manchester, about 90 miles, on 5 valves, and also by Mr. Ward, about 70-80 miles, easily, so I was informed by **2KQ** I might add that I have been heard fairly well at 5 miles, on about 20 volts H.T., all above, of course, are speech. Station call **2NA** has obtained similar results also. Finally, I may add that my aerial ammeter is quite O.K.

**2 H.F.**

Birmingham.
*April 20th*, 1922.

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# Book Reviews

THE "PRACTICAL ENGINEER" ELECTRICAL POCKET BOOK AND DIARY, 1922. (London: *The Technical Publishing Company, Ltd.* Twenty-third edition. Pp. 610 + cxxxiv. 3½" × 5½". Price, cloth 2s., leather 2s. 6d. net.)

This is the new annual edition of a handy reference book well known to most practical electrical engineers. It is mainly a note book of condensed information under 35 different headings. All the usual tables dealing with wire gauges, carrying capacities, cable constants, specific resistances, screw gauges, Whitworth's standards, are included, and have evidently been brought well up to date. Short articles are included on testing, instruments, transformers, motors, lamps, welding, etc., and, in short, a very great deal of information is compressed into a relatively small space. It is a pity that the Wiring Tables of the I.E.E., shown on page 95, *et seq.*, have the gauge expressed in S.W.G., whereas wires are now always referred to by their diameter in decimals of an inch (*i.e.*, 7/064, instead of 7 16, etc.).

The whole subject of wireless has been allotted ten pages only, five of which are devoted to spark transmission and reception with the old Marconi 31A crystal receiver. Valve reception is dealt with in one page and transmission in another; finally, the whole subject of wireless telephony is allocated just over half a page of text plus two diagrams. A choke control transmitter is illustrated but the illustration omits to show any iron core to the choke in the H.T. supply!

While the book is of no value to the wireless amateur from the point of view of information on wireless practice, it is distinctly valuable as a handy pocket collection of data regarding general electrical engineering. The diary gives one week to each page. Finally, a short dictionary of technical terms is given in French, Spanish and Russian; the Spanish portion is somewhat academic in its translations, witness "*Gomas Para Ruedas de Locomotoras*" for "*Tyres for locomotives*": we hardly think that rubber tyres have as yet become usual for even Spanish locomotives! F. P.

MARINE WIRELESS POCKET BOOK. By W. H. Marchant. (London: *Sir Isaac Pitman & Sons, Ltd.* 1922. Pp. 180. 4" × 6½". Price 6s. net.)

As is stated in the preface, this little book is very evidently intended for the guidance of the sea-going wireless operator, as comparatively few pages are devoted to *general* technical information. What information of that nature *is* given is set out very concisely and clearly, and is very much to the point. Some 70 pages are devoted to a description of the standard ship transmitters and receivers (spark) of the Marconi Company, Radio Communication Company and Telefunken Company, and there is little information in those pages of any interest to the amateur. Some 12 pages are devoted to the description of several types of Marconi valve receivers, but nothing new or of much interest is described. It is a pity that a book published so recently for the sea-going operator does not even mention the Marconi Standard Marine Receiver, using a single four-electrode valve to perform simultaneously the functions of H.F. amplifier, detector and L.F. amplifier. We understand that this instrument is being supplied to large numbers of ships, and is regarded as the standard valve receiver for ship work.

The book concludes with a few pages of regulations affecting ships and land stations, abbreviations, codes, time signals, weather reports, and a particularly concise and well-illustrated glossary.

In conclusion, while this book should prove of real use to operators and to those training as operators, it is of no utility to the average amateur. F. P.

# Calendar of Current Events

**Saturday, May 13th.**

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

*Afternoon.*—Visit to Victoria Telephone Exchange.

**Sunday, May 14th.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, May 16th.**

Transmission of Telephony at 7 to 7.25 p.m. on 700 metres, followed by C.W. calibration signals on 1,000 metres, by **2 MT**, Writtle, near Chelmsford.

**Wednesday, May 17th.**

NORTH MIDDLESEX WIRELESS CLUB.

8.30 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Advantages of Sectional Wireless," by Mr. Edward McT. Reece.

**Thursday, May 18th.**

INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "Electricity and Matter," by Prof. Sir Ernest Rutherford, K.B.E., F.R.S.

**Friday, May 19th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—"Valve Characteristics and the Practical Measurement of Valve Constants," by Mr. L. Grinstead.

INSTITUTION OF ELECTRICAL ENGINEERS. (LONDON STUDENTS' SECTION).

7 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2, "The Elimination of Atmospherics in Radio Telegraphy," by Mr. A. H. Reeves.

BIRMINGHAM EXPERIMENTAL WIRELESS CLUB.

7.30 *p.m.*—At the Digbeth Institute, "Elementary Wireless Telegraphy" (illustrated by lantern slides), by Mr. Frank S. Adams.

**Tuesday, May 23rd.**

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton, "The Electronic Theory," by Mr. Blakemore.

**Wednesday, May 24th.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Lecture by Dr. Richardson.

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (tea 5.30 *p.m.*).—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, "Some Effects of Capacity on Mutual Induction with special reference to their Application to the Elimination of Jamming," by Mr. J. H. Reeves.

**Friday, May 26th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"The Amateur Set," by Mr. T. Brown Thomson.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Edinburgh and District Radio Society.*

Hon. Secretary, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

The Society has been honoured by Sir J. Alfred Ewing (Principal of Edinburgh University), who has accepted the Hon. Presidency, and Mr. J. S. Smith (of G.P.O., Edinburgh), who becomes Chairman and Vice-President.

Other Vice-Presidents are :—Mr. G. D. Crichton and Mr. H. W. Clark.

Among other resolutions passed at the Annual Meeting of the 5th inst., the following are of general interest.

(1) Members in future must have attained the age of 18 years. Candidates under this age may become "Associate" members, and shall pay the reduced annual subscription of 5s. (in place of 12s. 6d.).

(2) The Council shall in future consist of six members, exclusive of the three V.P's., but including the Hon. Treasurer and Hon. Secretary., i.e., nine members in all.

A sale of apparatus will take place on Wednesday, May 11th, when the next General Meeting will be held.

Before the conclusion of the meeting a very hearty vote of thanks was accorded to Mr. Crichton for the admirable way in which he had filled the Chair during the past session, to the great benefit of the Society.

Mr. Crichton replied by thanking the Council for the enthusiastic manner in which they had assisted him.

Members are reminded that their subscriptions are now due, and will be gladly received by Mr. Crombie.

The close of our second year shows a very satisfactory position generally. Our balance-sheet shows a "cash in hand" balance of over £18. Our membership has passed 60, 50 per cent. of this number having receiving licences of their own.

During the next few weeks we hope to be established in our new Headquarters, c/o The Royal Scottish Society of Arts, at 117, George Street, which will be to our advantage in more ways than one.

### Cardiff and South Wales Wireless Society.*

On Thursday, April 6th, 1922, a joint meeting of the above Society and the Permanent Way Institution was held at Headquarters, Mr. N. M. Drysdale, presiding. Mr. A. W. M. Dyke gave a lecture entitled "Elementary Principles of Telephony." The lecture was highly interesting and instructive, the lecturer illustrating the many points dealt with by means of practical experiments. The Chairman, in proposing a hearty vote of thanks to the lecturer, remarked upon the great trouble which Mr. Dyke must have gone to in bringing such a large selection of apparatus from Neath.

Mr. W. Cleaver, Engineer, Port Talbot Docks, President of the P.W.I., thanked the Society for arranging the joint meeting, and stated that he would let the Secretary know when the P.W.I. meetings were being held at Cardiff, inviting our members to attend. Mr. G. Towers, Vice-President, Birmingham Wireless Society, who was on a visit to Cardiff, was introduced to the meeting. Mr. Towers expressed his delight at seeing such a flourishing Society at Cardiff.

A General Meeting was held at Headquarters on Thursday, April 20th, 1922. Mr. N. M. Drysdale occupied the Chair, when a discussion took place on "Methods of Coupling Valves." The Chairman, in his opening remarks, extended a hearty welcome to Mr. E. Ogden, P.O. Engineer, who, it was explained, is a very keen radio experimenter.

Mr. H. C. Linck in opening the discussion gave his experiences of (1) Resistance Coupling, (2) Reactance Capacity, (3) Transformer Coupling.

Mr. H. F. A. Sanderson detailed the difficulties met with in High Frequency working, and explained what steps he had taken in order to overcome these difficulties. Mr. H. Russell Jones related many of the experiments that he had carried out, the choke coil method being particularly good. Mr. E. Ogden in touching on the resistance capacity method said, that in view of the difficulty experienced in utilising this system for short-wave working, and the fact that the Amateur wavelength is likely to be altered to 400 metres, some other method suitable for short-wave reception would have to be devised. Messrs. H. W. Dowle, H. J. Price and Alex Lawrence also contributed valuable points of interest. Unfortunately, the evening passed all too quickly, the Chairman having to remind the meeting that time would not permit the discussion to be carried further that evening. A most hearty vote of thanks was accorded to all who had assisted in making the evening such a great success.

All gentlemen in the district interested in wireless are invited to communicate with the Hon. Secretary, Mr. P. O'Sullivan, 16, Adamsdown Square, Cardiff.

### Borough of Tynemouth (Y.M.C.A.) Radio and Scientific Society.*

Hon. Secretary, Mr. L. L. Sims, "Eynesbury," Cleveland Road, North Shields.

In connection with the above Society an exhibition of films was given recently dealing with Direction Finding on one of the principal air routes.

One of the members of the Society being connected with a local picture theatre, kindly arranged for the private projection, and the exhibition was thoroughly enjoyed by the splendid number of members and friends present.

The thanks of the Society are due to Messrs. Marconi's Wireless Telegraph Company for kindly loaning us the films.

After the show, the company had the opportunity of inspecting the operating and generating rooms

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of the theatre, the plant being one of the most up to date in the district.

On Monday, April 24th, the winter session of the Society was concluded under most enjoyable circumstances, a dinner having been arranged.

The President, Mr. J. E. Burnett, F.R.Met.S., presiding over a splendid attendance, amongst those present being Mr. Summers Hunter, C.B.E., Mr. Stanley Todd, Dr. Jas. A. Hislop and Mr. Rowland Lishman, J.P.

After the toast "The King" was honoured, the President proposed the health of the guests coupled with the name of Mr. Summers Hunter, C.B.E.

Mr. Hunter, who is a notable personality in engineering circles on the N.E. coast, gave an encouraging and inspiring address and related many incidents of his association with scientific men including the late Lord Kelvin.

The toast of the "Society" was proposed by Mr. Stanley Todd, Dr. Jas A. Hislop ably responding.

After the toast to the President, a welcome was given to the Secretaries of Newcastle and Sunderland Societies, who were present.

At intervals Mr. J. W. Yeates rendered amusing monologues.

The function was such an unqualified success that it has been decided to hold the dinner annually.

The first "field day" of the Society was held on Saturday, May 6th.

### Leicestershire Radio and Scientific Society.*

A highly successful dance was held at the Vaughan College on April 22nd.

The arrangements were admirably carried out by the Committee. The President, Mr. C. T. Atkinson, called for a hearty vote of thanks to Mr. G. Bennett for his excellent management of the lighting and colour effects and for providing an excellent jazz orchestra, and for the general success of the evening.

Thanks are also due to Mrs. Atkinson, Pratt, Wilkins, Messrs. Atkinson, Rudkin, Wilkins, and others for their help with the refreshments, and to the M.C's., Messrs. L. Dunkley and L. Pratt, pianist, Mrs. Eld, A.L.C.M.; violinist, Miss C. Blockley.

As will be seen from above, this Society has now taken up a more extended field of operation, and the first lecture under the new regime took place on April 24th, the title being "X-Rays," and the lecturer, Mr. A. E. Ball.

A brief history of the earlier work of Prof. J. J. Thomson and Sir William Crookes was followed by a display of Vacuum Tubes and so on, step by step, up to modern times, slides being used to illustrate practical apparatus and applications.

A welcome innovation was caused by the discovery that the Society had among its members present one of the earliest workers in the science under discussion, and at the invitation of the lecturer this gentleman, Mr. E. E. Brooks, B.Sc., augmented the description by some of his reminiscences. Home-made tubes were also shown by him, and a number of radiographs taken by their aid.

Most of the members present were allowed to view the bones of their hands, and sundry other objects, by the aid of the lecturer's apparatus, a most successful evening being spent.

In conclusion, the President of the Society, Cyril T. Atkinson, Esq., proposed a very hearty vote of thanks to the lecturer, Mr. Brooks, and the lanternist, this being seconded by Mr. Pallett, and heartily endorsed by the whole company.

All communications regarding the Society should be addressed to the Hon. Secretary, Mr. J. R. Crawley, 269, Mere Road, Leicester.

### The West London Wireless and Experimental Association.*

*Club Rooms*: Belmont Road Schools, Chiswick, W.4.

Meeting held Thursday, April 20th. Morse practice was given by Mr. H. Wilson. "Listening in" on short wavelengths was also carried out, the results not being up to expectation.

Mr. J. F. Bruce gave a very interesting address on the "Phillips" circuit, and fully explained his experiences and experiments carried out on same, many interesting and useful hints were given in connection therewith. Afterwards a debate was opened on the following subject, and as it will probably interest wireless amateurs as a body, I give the question here, and shall be pleased to hear from any wireless enthusiasts as to their experience: "Can a condenser in series with aerial be used on short wavelengths, say 200 metres, if an A.C. supply is in the locality? If not, what is the explanation?"

Hon. Secretary, Mr. Horace W. Cotton 19, Bushey Road, Harlington, Middlesex.

### Newcastle and District Amateur Wireless Association.*

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

On Monday, April 17th, the members of the above Association listened to a very interesting lecture by Capt. Stevens on "Wireless During the War."

The lecturer, who was engaged during the war in connection with signalling arrangements, related some very interesting experiences of early trials and difficulties in France, and touched upon power buzzer work and listening sets.

The Association expect to have the pleasure of hearing Capt. Stevens again in the near future.

### Liverpool Wireless Association.*

Hon. Secretary, Mr. James K. Wilkie, Junr., "Avondale," Knowsley Road, Cressington Park, Liverpool.

A meeting of the Liverpool Wireless Society was held at the Royal Institution, Colquit Street, on Thursday, April 27th. A paper was read, in the absence of Mr. Haggard (from whom the Secretary would like to hear) by Mr. James K. Wilkie (Hon. Secretary), on "Accumulators: How Made, Used and Abused." Mr. Wilkie passed round numerous exhibits of abused accumulators, and gave numerous notes on what to look out for when buying accumulators. Mr. Grindrod, who was in the chair, proposed a vote of thanks, which was seconded by Mr. Lamb and carried with applause.

It was decided to send a resolution to the Wireless Society of London, suggesting that they should send to all Members of Parliament a letter or pamphlet containing suitable data on the liberties of American amateurs and other points of interest

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to the wireless amateur this side, as the report recently published in *The Wireless World and Radio Review*, page 20, vol. X, No. 1, showed that the Hon. Members were evidently not in possession of the full facts.

### The Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting was held at the Leeds University on Friday, April 28th, Mr. A. M. Bage (Vice-President) taking the chair at 8 p.m. The Chairman called upon Mr. A. F. Carter, A.M.I.E.E., to deliver a lecture entitled "The Troubles and Trials of an Amateur."

Mr. Carter commenced his lecture with an explanation of how the amateur can become a very usual person if need be. He is extremely usual at any time, and the lecturer reminded us what the pre-war amateur did for us during the war. Mr. Carter interested his audience by relating some of his early efforts at the commencement of the war, when he was still mastering the mysteries of a piece of carborundum. Getting on to more modern questions, such as crop up nowadays, he paid particular attention to the difficulties that beset an amateur who plunges for a multi-valve set, using perhaps up to five stages of H.F. amplification and to work on the widest wavelength range. The lecturer then described various H.F. transformers he had used, and with the aid of blackboard sketches and diagrams showed how they could be made to function over a wide range of wavelengths. Proceeding, he explained the 7-valve set he had on view, comprising four stages of H.F. amplification, transformer coupled; the rectifier stage and two L.F. magnifications. He described the complicated-looking switchgear, and convinced the meeting that it was much more simple than it appeared. Many other constructional details were gone into very thoroughly, and the lecturer concluded his lecture after mentioning some results he had obtained with the set.

As is usually the case at the meetings of this society, the discussion was prolonged, but exceptionally interesting. A demonstration of the set in action was then given, using the lecturer's frame aerial. **LCM, POZ, HB** and unlimited 600-metre noise came in and was made audible to the meeting by use of a loud speaking telephone.

A hearty vote of thanks was accorded to Mr. Carter. Thanks are also due to the British Wireless Supply Company for providing the essential filament current. The proceedings terminated at 10.40 p.m.

The Hon. Secretary will be only too pleased to forward particulars of the Society to amateurs in Leeds and district. Annual subscriptions, 5s.; meetings twice monthly, no associate membership; number of members, between seventy and eighty.

### The Wallasey Wireless and Experimental Society.*

At the Fourteenth Meeting of the Society, held on April 27th, at 106, Albion Street, New Brighton, Mr. Mills lectured the members on "Home Instrument Making." The lecturer dealt first with the tools and materials needed; he explained that it was no use trying to do good work with poor tools and bad materials. He then explained the making of instrument cases and the polishing and finishing of the same. He then described the making of a short wave set, giving dimensions and complete directions for making each part. Mr. Mills' lecture was most instructive and entertaining. On its termination a vote of thanks to the lecturer was passed.

It has been decided to start a library of technical books for the use of the members; a small charge will be made, the proceeds going to the instrument fund. Several new members were admitted, bringing the total number of members up to thirty-six.

The Society still has room for a few members, and interested friends should write to the Hon. Secretary, 106, Albion Street, New Brighton, who will be pleased to give full particulars. Visitors will always be welcomed at the meetings each Thursday at 8 p.m. Membership cards are now available and can be obtained on application to the Secretary.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

At a meeting of the above Society held on Wednesday last, April 19th, at the Kingsland Assembly Rooms, a good attendance was recorded. New members still continue to flow in and the Society is getting a large membership. Arrangements are being made for the first camp, which is to be held in the New Forest in June, and some interesting experiments will be carried out. Quite a large amount of names have been given in to the Secretary for the week camp, which shows how keen the amateurs of Southampton are getting.

The buzzer practice which is given every week for 30 minutes to the members is showing good results, and it is a pleasure to state that practically every young member of this Society can read the Morse. The Society intends to continue its weekly meetings all through the summer.

A Meeting was held at the Kingsland Assembly Rooms on Wednesday April 26th. After the business of the evening, Mr. Freeman, Chairman, continued his lectures on "Single Valve Circuits," with a brief explanation of the terms rectification, H.F. amplification, and L.F. magnification, with the aid of rough blackboard characteristic curves, showing how it was possible to work the valve accordingly. The Chairman explained that H.F. amplification is by no means as straightforward a procedure as L.F. magnification. He concluded his lecture after the answering of various questions, and a demonstration was then given to the Press. Mr. Wansbrough was placed in charge of a three-valve receiver, and exceptionally good signals were recorded. With thanks to the Chairman and the Press, an enjoyable evening was brought to a close.

Any information required by any amateur in Southampton and district will be gladly given on application to the Hon. Secretary.

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## Ilford and District Radio Society.

At a meeting of the Society held on Thursday, April 20th, Mr. E. McT. Reece, representing Messrs. H. D. Butler & Co., lectured on "A Few Useful Circuits."

Developing his subject in a most interesting manner, Mr. Reece emphasised the necessity for having the aerial circuit in resonance by balancing inductance and capacity. This process must be repeated when using coupled circuits so that both circuits are in tune, and although any amateur worth his salt did this in the old days when crystals were universally used, modern amateurs are prone to regard single circuit working as sufficient and merely adopt the idea that an additional valve will overcome any losses. In view of the fact that, in proportion to the energy expended, a crystal is far more efficient than a valve, the best method of using a single valve is by adding it to a crystal circuit, preferably in front as a high frequency amplifier. The additional advantage of a potentiometer for adjusting the grid charge must not be lost sight of, and a demonstration proved that a considerable increase of signal strength could be gained by critical adjustment. Mr. Reece then explained a novel panel of his own construction, where, by means of plugs and switches, practically any known circuit can be quickly connected and additional steps of amplification, either H.F. or L.F., by merely lengthening the base board. Many different circuits were tried and criticised, and the simplicity with which alterations were made aroused the envy of many of us.

After the lecturer had illustrated a useful method of calibrating a set from tables published by the Admiralty, questions were asked by members and dealt with by Mr. Reece in such volume that our Chairman—Mr. H. Lassman—had eventually to close the meeting or Mr. Reece would never have got home.

On Thursday, April 27th, a concert and demonstration of radio telephony was held at the Society's Headquarters for the purpose of arousing local interest in our movements, and at the same time assisting club funds.

Much hard work had been put into the affair by our members, none of whom have had any previous experience in organising such public functions, and a packed hall was the extremely gratifying result. Several well-known artists, including Mr. Frederick Lennard and Bert Sinclair's Royal Concert Party, gave us music and humour, but the star turn of the evening to our uninitiated audience was the radio reception conducted by our Vice-President, Mr. J. E. Nickless, A.M.I.E.E. (**2 KT**). Speech and music transmitted from **2 ON** at Walthamstow and **2 JX** at Ilford were rendered audible all over the hall and a considerable distance outside by the distribution of three loud speakers. That mysterious person **QRN** was kind to us, and the clarity of the intense volume of sound was greatly appreciated. Many people could hardly credit at first that it was genuine. There is, however, no truth in the report spread by a doorkeeper that traffic was held up while tram and bus drivers stopped to listen.

When the transmission was over many members of the audience invaded the platform at the invitation of Mr. Nickless and inspected the apparatus, incidentally asking questions about the functions of the different parts. Naturally we had the dear old lady who wanted to know why we needed extra lamps when the lighting of the hall was so good.

It is believed that this most successful evening will considerably strengthen our members, while a cursory examination shows the financial aspect quite up to our expectations.

We still have plenty of room for new radio enthusiasts in the Society, and full particulars can be obtained from the Secretary, Mr. L. Vizard, 12, Seymour Gardens, Ilford.

## Dundee and District Amateur Wireless Association.

At a meeting of the above Association held at the Club Rooms, Morgan Academy, on February 21st last, Mr. A. Macleod lectured on "Telephony," and together with diagrams and blackboard sketches gave a most interesting lecture.

Mr. J. Grimes lectured on "Einstein's Theory of Relativity" on February 28th, and along with blackboard sketches made clear to members present several details in this most interesting theory.

At a General Meeting on March 21st the following members were elected office-bearers for the ensuing year.

President, Mr. A. Macleod; Treasurer, Mr. R. L. D. Kennedy; Chairman and Secretary, Mr. R. H. B. Candow; Committee, Messrs. A. Cram, J. Pellow, J. Ellis, R. Brown; Librarian, Mr. W. Bullians.

Mr. A. Macleod was then instructed to draw up plans for a single valve telephone transmitter.

On April 11th, Mr. Bruce, of Edinburgh University, lectured on the subject of X-rays before a large attendance of members, and in a very able manner described the various parts of apparatus, etc.

The attendance previous to Mr. Bruce's lecture has not been altogether satisfactory, and it is hoped that in future members will appreciate these lectures more than they have done in the past.

The annual subscription of 10s. is now due, and the Treasurer would be much obliged to receive subscriptions at an early date.

Particulars as to membership can be obtained from the Secretary, Mr. R. H. B. Candow, 33, Cowgate, Dundee, or by calling at the Club Rooms, Morgan Academy, Dundee, any Tuesday evening between 7.15 and 9.15 p.m

## Bolton Wireless Society.

A new aerial has now been fixed at Headquarters, and some very loud signals have been received. Good signals can be obtained from the usual American stations **WII, WQK, WSO,** etc. A two-valve H.F. amplifier is being constructed to go before the Society's A Mark IV three-valve set, and it is then hoped to get in the telephony stations.

Meetings of the Society from now will be held every Tuesday night, when, after the **2 MT** concert, morse practice will be held, after which, the meetings will be open for discussions, *impromptu* lectures, questions, and anything of general interest. Outings and visits will also be arranged and announced in due course.

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There are several persons interested in wireless in this district who have not yet attached themselves to any society. To those an urgent appeal is made to add their weight to the movement by joining the Society. The Hon. Secretary, Mr. H. Chadwick, 9, Raimond Street, Bolton, will be pleased to forward particulars to any prospective member, or to see them personally at the Headquarters, Bradford Buildings, Mawdsley Street, (opposite the Technical School), any Tuesday evening.

### The Wolverhampton and District Wireless Society.

The above Society made its first public appearance on Thursday evening, April 27th, when a Concert and Radio Telephony Demonstration was held in the A.J.S. Motor Works Assembly Rooms. Mr. Harry Stevens presided, and there was a large attendance. There was a most enjoyable musical programme, and the artists were Miss Maud Morgan, Miss Ethel Davis, Miss Elsie Turton, Mr, Arnold Devey, Mr. Stanley Eaton, and Mr. John Bourne.

During the interval a wireless demonstration was given on a frame aerial in the building. Songs and speeches by some of the artists in a distant part of the works were distinctly heard, and loudly applauded by the audience. The concert and demonstration were a decided success, and it is hoped to repeat it at a future date.

The next meetings will be held on May 23rd and June 6th, at 8 o'clock, when a series of discourses on the Electronic Theory will be given by a Mr. Blakemore, who is a science lecturer, and will be illustrated by special models. Prior to the meeting there will be buzzer practice commencing at 7 o'clock, at Headquarters, 26, King Street, Wolverhampton.

Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

### Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A general Meeting of the above Association was held on Thursday, April 27th, 1922, Room 74, Mechanics Hall, 7.30 p.m., when the members had the pleasure of listening to an interesting discourse upon the reception of very short waves. The lecturer, Mr. Allan, is to be complimented on the masterly way in which he dealt with the subject. We were also very interested in the piece of apparatus exhibited by Mr. Allan. The subject which always creates a wide field for discussion, did not fail to do so on this occasion, and from the views that were forthcoming it was evident that the members are very enthusiastic on this important branch of radio science. The meeting closed with a hearty vote of thanks to the lecturer for his magnificent effort.

### The Paddington Wireless and Scientific Society.

At an informal meeting, held in the Paddington Institute on Saturday, April 1st, it was decided to re-form the pre-war Paddington Scientific Society and incorporate a section for the study and practice of radio telephony and telegraphy. A committee of three was appointed, consisting of Messrs. A. L. Beak, G. Turton and A. Hoban, with Mr. L. Bland Flagg as Secretary. The organising Committee met on Monday, April 3rd and formed the propositions, which, if passed by the first General Meeting of the Society, would constitute its rules.

The first General Meeting was held on Thursday, April 27th, and was well supported. The items on the agenda included the enrolment of members, the passing of rules and the election of officers. Sixteen members were enrolled and these will be augmented during the coming weeks. The suggested rules were passed unanimously. The following officers were elected, and will hold office for one year: President, Mr. A. G. Cook, M.A., A.M.I.E.E.; Vice-President, Dr. J. H. Vincent, M.A., D.S.C., M.I.E.E.; Chairman, Mr. A. Hoban; Committee, Messrs. A. L. Beak (Librarian), G. Turton (Apparatus Steward), L. Bland Flagg (Hon. Secretary), and V. W. Venables.

The Society has at its disposal well-equipped laboratories for the research and experimental work in all branches of science, and a well-equipped workshop, where apparatus can be made to the personal requirements of members. The Society is applying for affiliation to the Wireless Society of London and is applying also for a receiving licence, and as soon as circumstances will permit it is intended to apply for a transmitting licence. A programme for the coming year is being arranged, which will include the reading and discussion of papers on scientific subjects, Morse, buzzer practice and demonstrations will be arranged from time to time.

The Hon. Secretary of the Paddington Wireless and Scientific Society, Paddington Technical Institute, Saltram Crescent, W.9, will be pleased to furnish particulars to any interested persons within the area of the Society. Subscriptions have been fixed at 2s. 6d. entrance fee and 5s. annually for full membership, and 2s. 6d. for associate membership.

### The North Essex Wireless Society.

Hon. Secretary, Mr. F. T. Smith: Headquarters, 15, Rayne Road, Braintree.

On Wednesday, April 26th, a very clear fundamental lecture was given for beginners by Mr. A. Jesceleyne, who explained how to make a cheap crystal receiver. Mr. Jesceleyne was thanked heartily for his excellent lecture, and he will be pleased to help any junior members who contemplate making the receiver he described.

### South Hackney.

Mr. E. R. Walker, of 48 Dagmar Road, South Hackney, E.9, would be glad to get into touch with any amateurs in the districts of Hackney, Clapton, Stamford Hill, Dalston and Victoria Park, with a view to forming a Society in that area.

### Radio Club Argentino.

A club has been formed in Buenos Ayres for the promotion of the study of wireless telegraphy and to bring together those interested in the science. The President is Señor Capitan de Fragata Luis F. Otlandini and the Secretary Señor Rafael A. Mastropaolo, Calle Belgrano 1732, Buenos Ayres. The Club has among its officers and members many gentlemen who are influentially associated with the development of wireless telegraphy in the Argentine.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"T.A.M." (London)** *asks for help with a crystal set which is giving very disappointing results.*

The circuit is correct, and if the makers' instructions are followed you should hear ships and stations such as **FL** and Poldhu. You should also hear Croydon telephony easily. Try various adjustments of the crystal, and if this is unsatisfactory, try other crystals. Make sure that there is no short circuit to earth on your aerial.

**"D.T." (Merthyr Tydvil)** *refers to Fig. 10 and Fig. 11, page 726, and asks for a diagram for the combined circuits using common batteries.*

In the diagram shown, Fig. 1, the circuits are combined and improved in general arrangement.

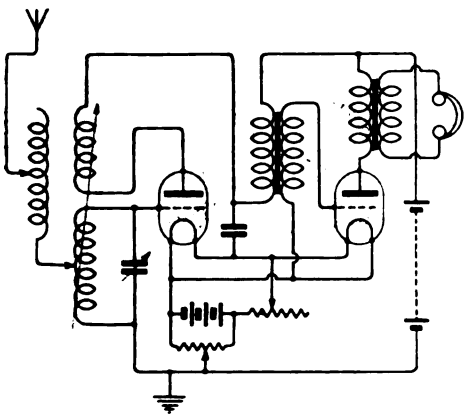

*Fig. 1.*

**"A.M." (Campbeltown)** *asks (1) For diagram of connections for two-valve resistance amplifier. (2) Diagram of a good set for general purposes. (3) For capacity for condenser. (4) Which of two aerials is the better to use. (5) Why his last questions were not answered within two or three issues of his writing.*

(1) See diagram, Fig. 2. (2) The circuit of Fig. 3, page 398, September 17th issue, is one of many quite suitable for your purpose. Please note that these columns are intended for the assistance of readers with specific difficulties, and not for the detailed design of sets for more or less freak requirements. (3) We cannot say, as you do not give enough information for us to obtain the thickness of the di-electric between the plates. (4) We prefer the single wire. (5) We cannot answer questions in less than about a month, owing to the time taken to put a technical magazine of this nature in print. Replies are dealt with as far as possible in rotation, and with the large number

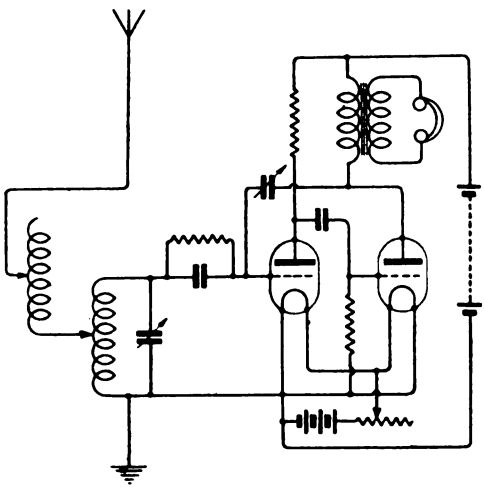

*Fig. 2.*

received a delay of more than a month has been unavoidable in every case. It is hoped, however, now that this journal is issued weekly, to reduce the delay in the insertion of replies.

**"B.C.G." (Kenilworth)** *asks (1) The inductance of a coil 8" in diameter, wound with 20 turns of No. 7/36 Litz. (2) Inductance of a variometer wound with similar wire. (3) Inductance of a variometer wound with 27/40. (4) Where to get a long range wavemeter calibrated.*

(1) 1,600 mhys. (2) and (3) Neither of these variometers admit of exact calculation, but the maximum in either case should be about 130,000 mhys., with a minimum of about 80,000 mhys. (4) We do not know of any concern specialising in this sort of work, but think that most of the larger makers of wireless apparatus would undertake the job for you.

**"E.R." (Brussels)** *asks (1) For criticism of a set. (2) For information about the tuning of H.F. transformers. (3) The relative resistances of the internal and external parts of an anode circuit. (4) For the effect of loose coupling with autodyne sets.*

(1) Do not use resistance capacity coupling at

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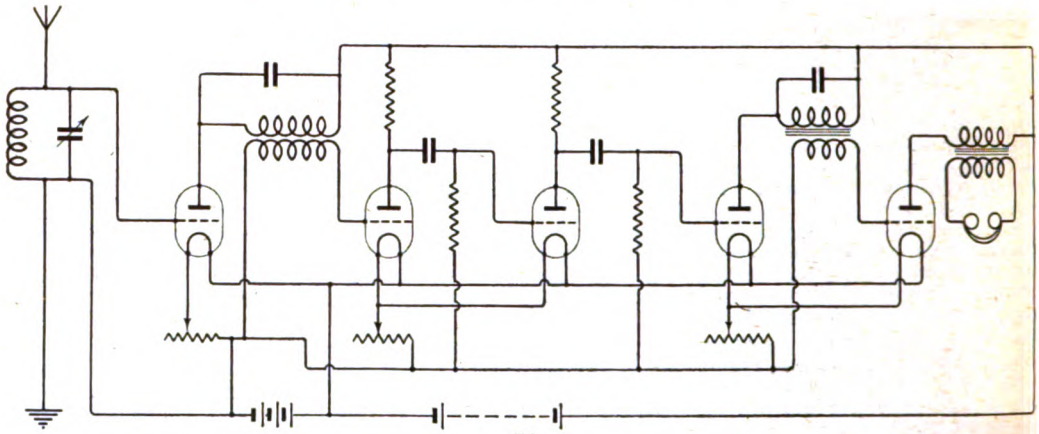

*Fig. 3.*

short wavelengths. Reaction should be in the anode of the rectifier. If the separate heterodyne is strong, couple it to the grid of the rectifier. If weaker, couple to one of the earlier valves. A common battery arrangement is shown in the diagram, Fig 3. (2) Only one winding should be tuned by a condenser, the tight coupling between the windings then gives the effect of tuning both circuits. (3) The condition of equality of internal and external resistance only holds in the case of resistance amplifiers, not in the case of resonance transformers. (4) The effect is probably due to the set having two distinct possible periods of oscillation, one governed by the constants of the closed circuit, and the other by those of the combined closed and aerial circuits. Tightening of the coupling causes a rapid change over from one state of oscillation to the other.

"**D.P.**" **(Anfield)** *asks how to connect up a condenser, a valve panel, and a coil holder—the external connections of which he sends, but the internal wiring of which he knows nothing about.*

As we are unacquainted with the wiring of the panel, we can only suggest a wiring which will suit its most probable arrangement (Fig 4). The set may, of course, not work if the panel happens to be differently arranged. The leads to the terminals marked "Tune" may need interchanging.

"**I.D.A.**" **(Wellington)** *asks* (1) *If plug-in transformers are suitable for an H.F. amplifier given in a back number.* (2) *Number of turns and gauge of wire for* 1,100 *metres on a* 1" *diameter transformer.* (3) *Diagram of a two-valve set to work in conjunction with an existing set.* (4) *If* **PCGG** *will be heard in Cheshire on two H.F., one detector and two L.F. valves.*

(1) Yes. (2) Each winding should be about 3' long, of No. 40 wire. A small variable condenser will probably be necessary across one winding. (3) See diagram (Fig. 5). (4) Yes.

"**W.E.J.D.**" **(Newbury)** *asks* (1) *Where to obtain French valves.* (2) *If a single valve circuit shown will work satisfactorily.*

(1) The "R" valves, listed by many of our advertisers, with prices of 10s. upwards, are examples of the type known as "French." (2) Yes, provided the inductances are correctly pro-

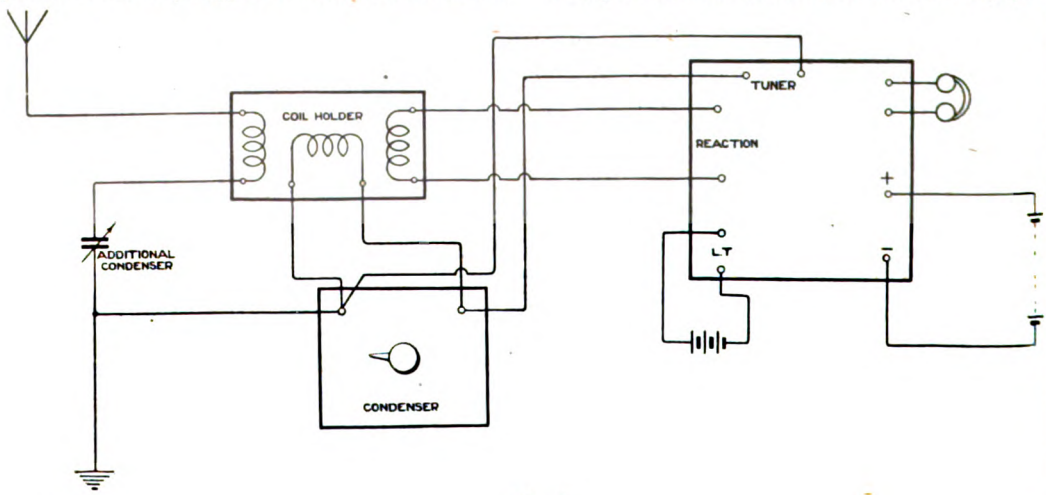


*Fig. 4.*

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portioned and a 0·001 mfd. condenser is connected across the telephones.

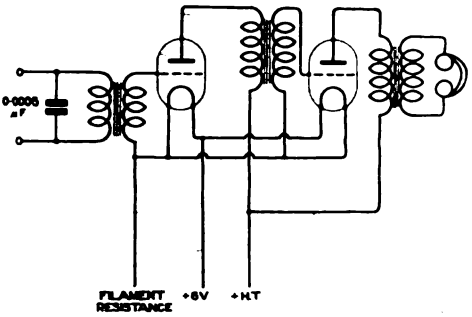


*Fig. 5.*

**"S.A.P." (Copenhagen).**—Your theory of the action of grid condenser is fairly correct as far as it goes, but it neglects various subsidiary effects, which in practice considerably modify the action. We have not space to go into the matter fully here, but may point out that some sets work better with the leak connected to the negative side of the filament and some with it connected to the positive. In any given case find which is best by experiment. We are more than a little sceptical of your statement that the grid charge in a certain instance raised the potential of the battery sufficiently to burn the valve out. (2) Try about an ounce of No. 40 wire wound in a few layers along an iron core ¾" diameter and, say, 8" ong.

**"MICROHENRY" (Barnet)** *asks* (1) *Gauge and material of a sample of wire.* (2) *How to calculate the natural wavelength of an aerial.*

(1) No. 20 phosphor bronze. (2) The natural wavelength is between 4 and 4·5 times the length of the aerial, including the down-lead. In a "T" aerial only half the length of a horizontal part should be counted.

**"MIDGE" (Chelmsford)** *asks* (1) *If possible to receive* **2 MT** *telephony on a crystal set at* 18 *miles.* (2) *Gauge of a sample of wire.* (3) *If the same could be used for a transformer in a single valve set to put the rectified signals back on to the grid for L.F. amplification.* (4) *If a transformer will affect the wavelength of the set.*

(1) Yes. (2) No. 38, S.S.C. (3) Yes. Transformer should have a 1/1 ratio with about 5,000 turns on each winding. (4) No. Provided there is a condenser of 0·001 mfd. across the winding in the grid circuit. There should also be a similar condenser across the telephones.

**"AMATEUR" (Walsall).**—(1) The arrangement suggested is rather cumbersome, with very little indeed to recommend it. We think you would find the circuit of Fig. 4, page 32, April 1st issue, will meet your requirements. We do not advise any more complicated switching stunts. (2) Yes, if properly proportioned. (3) We are unable to calculate the inductance of the coils, as you do not state the diameter.

**"W.A.R." (Heywood)** *asks* (1) *For a diagram of a set with three valves and a crystal.* (2) *If this would receive* **PCGG.** (3) *Windings for* 1,200 *metres H.F. transformer.*

(1) A crystal is hardly necessary in combination with so many valves, but see diagram (Fig. 6). (2) It should do so. (3) See reply to **"I.D.A." (Wellington),** above.

**"P.O.P." (Stratford-on-Avon).**—The crystal diagram is not quite correct. The blocking condenser should be across the telephones. The battery should be applied to the crystal through a potentiometer. *See* Fig. 4, page 813, March 4th issue. The information regarding the single valve set will be found in the same issue, Fig. 2, page 811. For 6,000 metres the A.T.I. may be 10" × 6" of No. 26. To increase the range another 2,000 metres add an additional coil of 8" × 6" of No. 26.

**"C.G." (Cardiff)** *refers to magnetic detectors and asks if the same can be used with valve amplification for receiving C.W. and spark.* (2) *Failing combination with valve set, what tuning inductance and condensers should be used for receiving short wave signals.*

(1) A valve might be used for magnification after

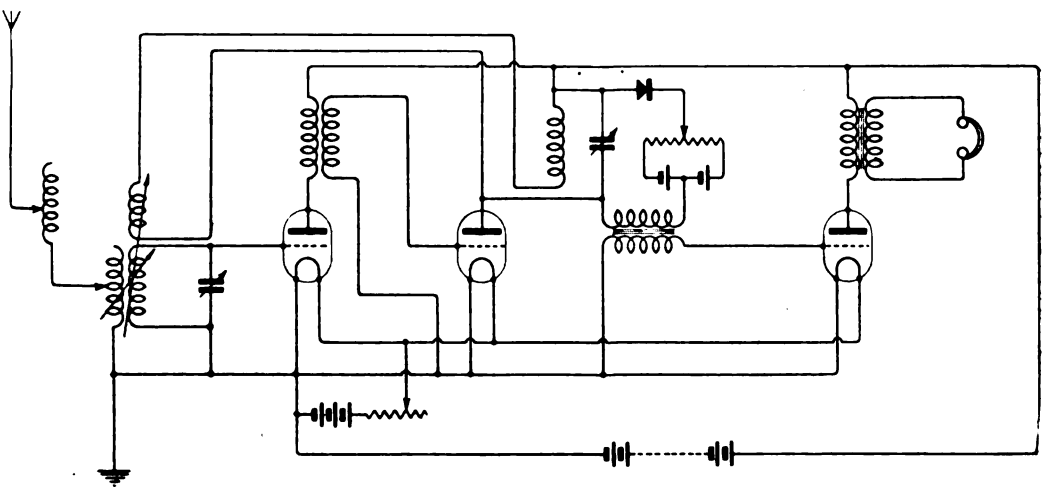

*Fig. 6.*

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magnetic detector for spark stations. For C.W. the magnetic detector could be used after a valve autodyne H.F. amplifier, but this arrangement would be most inefficient. (2) The magnetic detector is highly inefficient on small amateur aerials, and we should very strongly advise you to use a valve or crystal as detector. Tuning circuits for a magnetic detector are the same, except that a much bigger ratio of capacity to inductance is required, and the magnetic may be introduced direct into the aerial circuit.

**"L.R.G." (Cheshire)** *asks* (1) *How to improve his set.* (2) *If suitable for telephony.* (3) *If L.R. telephones and transformer will be more efficient than* 2,000 *ohm. telephones.* (4) *How to increase sharpness of tuning.*

(1) Circuit is incorrectly arranged, see diagram (Fig. 7). (2) This is not the most efficient way of using three valves, but you should certainly hear **FL.** (3) There will not be a great difference in strength, but the transformer arrangement is distinctly preferable on other grounds. (4) This will follow from the suggested rearrangemnt of the circuit.

so large a range. (2) A suitable arrangement is shown in Fig. 4, April 1st issue.

**"AMATEUR" (Norway)** *is making a three-valve set with tuned anode circuits, grid condensers and leaks, and asks* (1) *Best values for coupling condensers and leaks.* (2) *If anode tuning coils should have same number of turns as the primary of an H.F. transformer.* (3) *If the amplifier will be as good as transformer amplifier.* (4) *If Weston moving coil relay may be used with the above set for recording.*

(1) About 0·0005 mfd. and 2 megohms. (2) Not necessarily. The coils should be of the size which will tune to the required wavelength with the condenser C.3 and C.4. (3) The amplification should be better than with a transformer coupled set, but it may be somewhat difficult to stop the set from oscillating. (4) Yes.

**"J.H.B." (Partick)** *asks* (1) *How to construct a frame aerial.* (2) *If* 100′ *wire run round the walls of a house on insulated hooks would be any good.* (3) *If P.O. licence would be necessary for the above arrangements and if they should give* **2 MT.**

(1) A good article on this subject appeared in

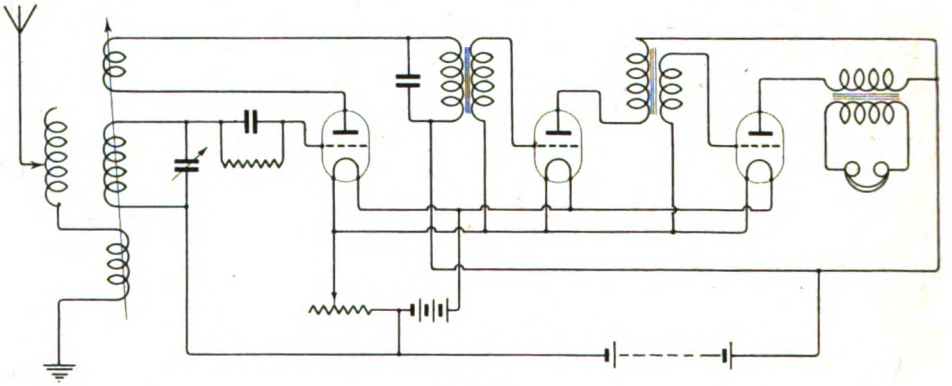

*Fig.* 7.

**"T.R.J." (Birmingham).**—(1) Circuit is correct as shown. (2) It is better to connect the reaction coil in the anode of the rectifier. (3) No. The S.I.C. of glass varies between about 3 and 10 with different variations in the composition without much change in specific gravity. Glass for condenser plates generally has a value of about 6. (4) In your case there must be sufficient inductance in each so that the circuits are tuned to the same wavelength with their respective condensers. There is no constant proportion : for instance, if a loading coil is used in the aerial circuit the primary of the loose coupler may be many times smaller than the secondary.

**"D.A.C." (Walthamstow)** *asks* (1) *If circuit of Fig.* 3, *page* 617, *December* 24*th issue, will work with duolateral coils with suitably tapped H.F. transformers for* 300 *to* 30,000 *metres.* (2) *For diagram to cut out switching arrangement of H.F. or L.F. valve.*

(1) Yes, or a single tuned circuit receiver may be used for the longer wavelength. It has often been pointed out in these columns that it is not possible to construct an efficient H.F. transformer to cover

the issue of June 12th, 1920, which can still be obtained from the publishers. We have not space to treat the matter adequately here. (2) This will not be very satisfactory, partly owing to all the wires being horizontal and partly to their being near bad di-electric material in the walls, which will lead to serious losses. (3) Yes. (4) Unlikely, without more than two valves.

**"X" (Malton).**—(1) We prefer 3 H.F. to 3 L.F. (2*a*) We cannot give the reason for loss of strength in this case without fuller particulars of the circuit. In case (*b*) result is evidently due to poorness in the design or construction of the telephone transformer ; but in any case the use of 1/1 transformer, which can obviously never be perfectly efficient, is bound to give some weakening of signals. This is often worth while, on account of the better working of the set obtained. (3) A suitable switching arrangement for adding a L.F. valve is shown in Fig. 4, page 706, February 4th issue.

**"SIRIUS" (Brighton)** *asks how to add an H.F. valve to a single valve set, shown.*

*See* diagram (Fig. 8).

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**"A.J.G." (Peckham).**—(1) The set referred to should be satisfactory. (2) Yes. (3) There is no risk in using H.R. telephones without a transformer, unless exceptionally high voltage valves are used. (4) Two "Ora" valves may be used. It is generally a mistake to mix different sorts of valves except for specific purposes.

**"G.E.B." (Birmingham).**—(1) The formula you quote is applicable to the parallel arrangement fairly accurately, provided that the C of the formula is the sum of the added capacity and the capacity of the aerial. The formula does not hold for the series case, and is never strictly true, owing to the

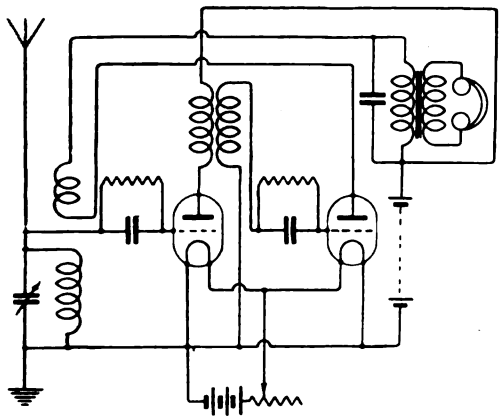

*Fig.* 8.

distributing inductance and capacity of the aerial. (2) The suggested scheme should be quite satisfactory. (3) The No. 1 coil might have about 500 turns, No. 2: 1,000 and No. 3 1,500 turns, winding width being about 1" in each case. For reaction use the size next smaller than the tuning coil. (4) These valves should be quite satisfactory and would take about ¼ ampere each.

**"A.G.J." (Braintree)** *asks for windings of the circuit of Fig.* 1, *page* 560, *December* 10*th issue.* (2) *If Mark III coupling coils would be suitable for the coupling in this circuit or in that of page* 65, *April* 13*th*, 1920. (3) *If this coupler could be used on a set loaded up to* 3,500 *metres for telephony.* (4) *If L.F. reaction could be introduced into either of the circuits named.*

(1) We have no practical experience of the working of this circuit, but its underlying principles appear to us of questionable utility. We much prefer later circuits in this article, such as, for instance, No. 2. If you try the circuit of Fig. 1 we should give the two coiled circuit inductances the normal tuning values and wind the secondary of the coupler on the same former as the primary, separated from it with Empire cloth, and of about No. 36 wire. (2) Not for the circuit of Fig. 1, but it could be used for the circuit of page 65. (3) Coupler might be used on this wavelength if rewound with about No. 34 wire. (4) We do not recommend the use of true L.F. reaction, which is very liable to produce unmanageable "howls." Low-frequency back coupling for the purpose of re-amplification may, however, be used, as, for instance, in the circuit of Fig. 2, page 561.

**"W.T.E." (Listowel).**—(1) Circuit is correct, except that the condenser should be in parallel with A.T.I. for 7,000 metres. For short waves it is better on the aerial than the earth side of the A.T.I. (2) Condenser 0·001 mfd. A.T.I. 8" × 5" of No. 26. Reaction coil 6" × 4" of No. 28. (3) 120 ohm telephones with a transformer. If used, put the transformer on the positive side of the H.T. battery. (4) Arrange the reaction coil to slide inside the A.T.I.

**"A.C.T." (Hemel Hempstead).**—(1) A circuit might be on the lines of that shown in Fig. 3, page 398, September 17th issue, though we do not think that the 1.25 transformers will be of much use. (2) We cannot say the wavelength without more information about the condensers, but probably the maximum will be 2,000 to 3,000 metres. (3) Yes. The correct polarity should be found by experiment. (4) We prefer the twin aerial.

**---------- (Oundle).**—(1) The suggested type of amplifier could be used, but only with the addition of an anode resistance or impedance for each valve, and also a coupling condenser. The circuit would then closely resemble the normal resistance capacity circuit. Common H.T. can then be used. (2) We are afraid the scheme is of little practical utility. (3) About 0·00045 mfd. (4) The most obvious improvement is the addition of a reaction coil. The next is the substitution of two loosely coupled circuits for the single circuit shown, also the connections of all the plate circuits in the diagram are wrong. After attending to these points high-frequency amplification can be added if desired.

**"H.F." (Woking)** *asks* (1) *If a circuit is correct.* (2) *If it will receive* 2 MT. (3) *If* 1,000 *ohm telephones are suitable.* (4) *For the meaning of reaction.*

(1) The circuit is correct as far as it goes, but it would be greatly improved by a tuning condenser across the anode coil. (2) Yes, particularly if altered as suggested. (3) These will be fairly satisfactory. (4) An adequate explanation of this matter would take more space than we can afford. Consult Bangay's "Oscillation Valves," or other elementary textbook.

**"D.B.F." (Mayfield)** *only gets* PCGG *weakly on a one-valve set, and asks* (1) *If adding a resistance capacity amplifying valve would improve it.* (2) *If so, how to connect it.* (3) *If rectifying with a crystal would give better results.* (4) *A sketch, showing how to do this.*

(1) and (2) Yes. A suitable circuit is shown in Fig. 3, page 812, March 18th issue. The anode resistance may be 50,000 ohms. (3) and (4) This will not be as good as two valves, but would be better than the single valve set. For circuit, *see* Fig. 4, page 61, April 8th issue.

**"G.A.H." (Farnborough)** *asks* (1) *How many yards of No.* 40 *wire will have a resistance of* 50 *ohms.* (2) *For the gauge of two samples of wire.*

(1) Approximately 40 yards. (2) A is No. 42 and B is No. 40.

**"R.B.W." (Gillingham)** *has a set as Fig.* 3, *page* 812, *which has worked well until recently. He now gets scratching noises in the telephones, and asks why.* (2) *If it might be due to the telephones burning out.* (3) *If he can use No.* 38 *wire for a reaction coil.* (4) *If not, what gauge to use.*

(1) and (2) This may be due to a partial burn-out

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of the telephones, breakdown of the grid condenser, defective battery (probably H.T.), defective valve, or a bad connection somewhere in the circuit. (3) and (4) This may be used, but we should prefer about 4″×3″ of No. 32 or No. 34.

**"A.H.C." (Streatham)** *asks if it would be possible for two sets on one aerial to receive C.W. on different wavelengths simultaneously.* (2) *If two* 100′ *single wire aerials, lying at right angles to each other from one point, would be as liable to interfere as two* 50′ *aerials running parallel to each other,* 100′ *apart.*

(1) This can be done, particularly if the wavelengths to be received are well separated and so that no harmonic of either lies very close to the other fundamental. It could be most easily done by using separate heterodynes for each set, instead of allowing the sets themselves to oscillate. (2) There would probably not be much to choose between these arrangements. In neither case will interference be very bad, unless you use re-radiating circuits.

**"C.H.K." (London).**—To receive **PCGG** it will be necessary for you to alter the windings of the Mark III tuner as described in the articles in the issues of March 5th and 19th. You could then arrange the C Mark III panel for H.F. amplification, transformer coupled, and rectification, using the "Tb" amplifier for note amplification if desired. The section marked "long" should consist of several 1·5 volt cells connected in series, and that marked "short" should be a single 1·5 volt cell. The size of the cells used is unimportant.

**"J.V.T." (Bermondsey)** *asks* (1) *For necessary apparatus to adapt a crystal set for C.W. reception.* (2) *For suitable circuits if his are unsatisfactory.* (3) *If the revised set will receive telephony.*

(1) A valve, 6-volt accumulator, filament resistance, H.T. battery, a potentiometer, reaction coil and valve holder. The circuit will then be on the lines of Fig. 6, page 775, March 4th issue, but with the telephones in this case on the earth side of the H.T. battery. With somewhat more gear a valve and crystal set as Fig. 4, page 813, could be used. (2) Your circuit should be satisfactory. Reaction coil may be 5″×3″ of No. 32. (3) Yes.

**"SPARKS" (Wolverhampton)** *asks* re *the pocket set in March 4th issue.* (1) *For information about the aerial tuning condenser.* (2) *How to make the grid leak.* (3) *If the wavelength range can be increased efficiently.*

(1) We have no further information, but from the description, which is not very clear, we imagine the moving plate should be pivoted at the left-hand bottom corner and rotated by the handle. We should recommend covering the tinfoil on both sides of each plate with mica. (2) By rubbing down pencil lead on a small piece of roughened ebonite or slate. (3) The wave range could no doubt be extended by increasing the size of the coils, but this would involve increasing the size of the set. We should not recommend any considerable increase.

**"J.A.C." (Forfar)** *is troubled with jamming on a single circuit receiver, and asks if that of Fig.* 3, *page* 705, *will give as loud signals and greater selectivity.* (2) *For the value of the reaction condenser.* (3) *If magnetic reaction might be used.*

(1) Certainly. Keep the coupling between the A.T.I. and the closed circuit very weak. (2) Probably somewhat less than 0·0001 mfd. It might be found better to put it between second plate and the first grid. (3) Yes, we prefer this. Introduce it in the last plate circuit and couple with the closed inductance only.

**"C.L.P." (Birmingham)** *has a slab coil tuner which gives very critical tuning for telephony. He asks* (1) *If the use of solenoid coils would improve this.* (2) *Dimensions and windings for* 1,200 *metres.* (3) *Which is the better for telephony, H.F. or L.F. amplification.*

(1) The type of coil used will not make much difference. Tuning is nearly always critical with telephony, particularly with good coils. It is not to be regarded as a drawback unless floppiness of reaction is also present. You could get easier tuning with a small capacity Vernier condenser in parallel with your main condenser. (2) A.T.I. may be 7″×5″ of No. 22, reaction coil 5″×4″ of No. 28. (3) For general purposes we prefer the H.F.

**"NOVICE" (Swinton).**—(1) You will probably not get serious interference with the telephone wires with your aerial arranged as shown, which appears to be the best that you can do. You may, however, find difficulty in obtaining permission to place your wires so close to the telephone lines. If this is the case, you will have almost no alternative but to use a frame aerial with, say, a three-valve set.

**"DUBIUM EST" (Monkseaton)** *asks* (1) *For help with a resistance amplifier which gives poor results on* 1,000 *metres.* (2) *Whether the reaction coil should be in the H.F. amplifier or in the detecting anode.* (3) *Why a different set of stations are heard by reversing the side of the reaction coil.* (4) *If jamming by* **GCC** *could be kept out by introducing a variometer tuned to* 600 *metres in the grid lead to the valve.*

(1) Resistance amplification is never very good at 1,000 metres, but it should be much better than you suggest. A capacity of 0·001 mfd. is too big for this wavelength; try nearer 0·00005 mfd., and try various values of grid leak. (2) Reaction from the rectifying valve is the better because of the larger currents flowing in that anode circuit. (3) We regret that we cannot explain this somewhat unusual phenomenon. (4) This would have some rejector effect, but it would be better to put an ordinary tuned circuit in place of the variometer, which is probably only tuned by its own self-capacity. The results of this experiment are, however, not likely to be very good, at any rate until you use a two, or better, three-circuit, receiver, with the circuits very loosely coupled.

## SHARE MARKET REPORT

Prices as we go to press on May 6th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 8 | 6 |
| „ Preference .. .. | 2 | 6 | 3 |
| „ Inter. Marine .. .. | 1 | 9 | 6 |
| „ Canadian .. .. | | 10 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | 1 | 1 | 3 |
| Preference .. .. .. .. | | 14 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
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## Short-Wave Directional Wireless Telegraphy*

By C. S. FRANKLIN.

DIRECTIONAL wireless telegraphy is as old as the art itself, for Hertz made use of reflectors at the transmitting as well as the receiving ends in order to augment the effects, and to prove that the electric waves which he had discovered, obeyed, to a considerable degree, the ordinary optical laws of reflection. Senatore Marconi in his earliest endeavours to develop a telegraph system using electric waves, also employed reflectors to increase the range and get directional working.

The discovery by Marconi of the great increase of range obtained by the use of longer waves, and the earthed vertical aerial, practically stopped development on directional lines for the time being. The demand of the time was for increased ranges; and as the first practical application of wireless telegraphy, namely, working to and between ships, required "all round" working there was very little call for directional systems.

To-day the range has arrived at the maximum possible on the earth, and the wavelength has increased to such an extent that the frequencies proposed are within or near to the limits of audibility. The possible gamut of wavelengths is becoming very fully occupied, and although the development, during the past four years, of nearly pure continuous-wave transmitters, and of receivers with vastly improved selective powers has eased the problem, the time will soon arrive when practically the only way of increasing the number of possible services will be by employing systems having good directional characteristics.

There are, broadly, two general classes of directional aerial systems:

A. Those having the general characteristic that their directional power or polar curves are nearly independent of their dimensions. The directional result is obtained by opposing the effects of a number of aerials, or parts of an aerial with suitable phasing adjustments; the degree of opposition being a function of the direction. Systems of this class may be made small compared with the wavelength employed; for the purposes of position finding, and as receiving systems enabling interference to be eliminated from several directions, they have already been developed to a considerable degree. The simplest example of this class is the well-known frame aerial. By employing a sufficient number of aerials the system may, theoretically, be given any desired sharpness of directional power without making the dimensions large; this can, however, only be done with a large sacrifice of receiving or radiating power.

B. Those having the general characteristic that their directional power or polar curves depend on their dimensions relative to the wavelength employed. In this class the directional result is obtained by adding the effect of a number of aerials, or parts of an aerial, when working in the required direction. The underlying principle is that the effects, for the required direction, are integrated over a wide front in proportion to the wavelength. Such systems can, therefore, only have small dimensions when using short waves, and this fact makes their development difficult.

As examples of such systems may be mentioned—

(1) Reflector systems in general.
(2) Systems composed of lines of aerials, at right angles to the working direction, correctly adjusted as regards phase. In this may be included the Alexanderson long aerial with its feeders.
(3) The Beverage long, horizontal receiving aerials. This aerial and equivalent arrangements form a class by themselves, but have the characteristic that the directional power is a function of the dimensions.

The reflector system was the first one that was tried for wireless telegraphy; it has been considered by several investigators, but very little research work on such systems has yet been published. Useful research work on these lines is not easy; the use of reflectors of reasonable dimensions implies very short waves of the order of a few metres. The very high attenuation of such waves over land or sea, and the difficulty of getting much power

*Abstract of a paper read before the Wireless Section of the Institution of Electrical Engineers on Wednesday, May 3rd, 1922.

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into them, tended to make early attempts very discouraging.

In this paper it is proposed to give some results of investigations made with reflectors and wavelengths below 20 metres. It is also hoped to be able to give a demonstration with a continuous-wave valve transmitter furnishing approximately a 1-metre wave, and a reflector having a 2 wavelength aperture, so that some idea can be got of the order of the directional effect, or "beam" obtained.

The investigation was commenced by Senatore Marconi in Italy in 1916, with the idea of developing the use of very short waves, combined with reflectors, for certain war purposes. The author assisted him there, and it was very interesting work, as it was like being back in the very early days of wireless when one had a perfectly clear field.

The waves used were 2 metres and 3 metres. The only interference experienced with such waves is from motor boats and motor cars. These machines apparently emit waves from near 0 up to 40 metres in length, and the day may come when they will have to have their ignition systems screened, as on some aeroplanes, or carry a Post Office licence for transmitting. Incidentally, if some of the motorists were to listen to the irregularity of their ignition, they would have a fit. At Senatore Marconi's suggestion a coupled-circuit spark transmitter was developed, the primary having an air condenser and spark in compressed air. By this means a moderate amount of energy was obtained, and the small spark-gap in compressed air proved to have very low resistance. The decrement of the waves emitted was judged to be of the order of 0·03.

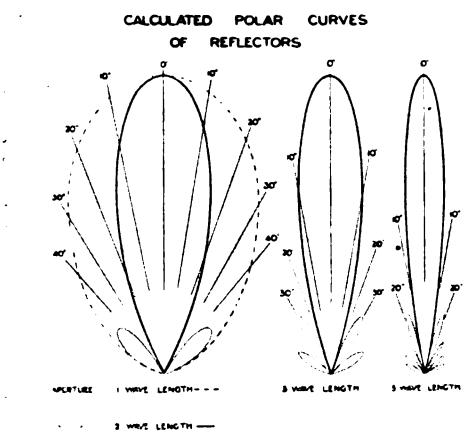


*Fig.* 1.

The receiver used was a carefully picked crystal, while the reflectors employed were made of a number of strips or wires tuned to the wave, arranged on a cylindrical parabola with the aerial at the focus. The transmitting system was arranged so that it could be revolved and the effects studied at the receiver.

Assuming that the waves leave the reflector as plane waves of uniform intensity, having a width equal to the aperture of the reflector, it is not difficult to calculate the polar curve of radiation in the horizontal plane, which should be obtained from reflectors of various apertures. In Fig. 1, are shown the calculated curves for apertures of 1, 2, 3 and 5 wavelengths.

The method of measurement at the receiver was the well-known "slide back" method with a rectifier; this method if calibrated against an adjustable local generator is quite reliable to a few per cent., and has given very consistent results.

Reflectors having apertures up to 3½ wavelengths were tested, and the measured polar curves agreed very well indeed with the theoretical curves. The use of two reflectors with apertures of 3½ wavelengths, one at the transmitter and one at the receiver, increased the working range about 3 times.

These Italian experiments showed that good directional working could be obtained with reflectors properly proportioned with respect to the wavelength. The attenuation over sea for the wavelength used was found to be very high, and with the apparatus available the maximum range obtained was 6 miles.

The experiments were continued at Carnarvon in 1917. With an improved compressed-air spark transmitter, a 3-metre wave and a reflector having an aperture of 2 wavelengths, and a height of 1·5 wavelengths, a range of over 20 miles was obtained to a receiver without a receiving reflector. The experiments at Carnarvon brought into prominence a property of wave propagation which, the author thinks, is not generally known, and the extent of which is not realised. This is the very rapid increase in the strength of the electric field with height above the ground. The rate of increase appears to be a function of the height divided by wavelength, and while not very noticeable with waves of several hundred metres, is very marked with waves of a few metres, length. The order of the effect may be gathered from the following experimental results.

It has been mentioned that the range attained at Carnarvon with a 3-metre wave was over 20 miles. The transmitter was at a height of 600 ft. and the receiver 300 ft., there being a clear air line between them. To the shores of Carnarvon Bay, 7 miles from the transmitter, there is also a perfectly clear air line, yet the signals at sea level were much weaker than at 20 miles with the receiver 300 ft. up. It was not possible to ascribe the weakness of signals to any screening or reflections from trees or other objects. Tests were made at different levels on a hill situated at this point, and it was found that signals steadily increased in strength with height. Accurate measurements were not possible with the portable receiver, but the increase of strength of the field at a height of 10 wavelengths was estimated to be 6 or 7 times. Further tests on this effect have shown that the increase of strength with height is not always uniform.

Subsequently when this reflector and transmitter used at Carnarvon were brought down to sea level, it was found that the limiting range to the same receiver at sea level and over sea was 4 miles. When both transmitter and receiver are at a low level the range is very dependent on the nature of the intervening country, and is very restricted even over sea; when, however, both stations are many wavelengths above the intervening country its nature is of far less importance, and the range is increased many times.

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These experiments showed that very considerable ranges were possible with very short waves.

In 1919 experiments were commenced at Carnarvon with valve transmitters, with the idea of producing a directional telephone system. Mr. R. H. White and Mr. E. Green, and, later, Mr. A. W. Hall, assisted the author in this work. A wave of 15 metres was selected, which while well within the capacity of the power valves available, allowed a simple reflector to be used without too large a structure. After some trials a single valve transmitter was arrived at taking about 200 watts with a 15-metre wave, and giving 1 ampere in the centre of a half-wave aerial. A heterodyne receiver with supersonic beat-note was employed.

After gaining some experience, and solving many small practical difficulties, very strong speech was obtained at Holyhead, 20 miles away. The strength was such that shadows produced by small hills and buildings were hardly noticeable, unless the stations were close behind them.

The next point was to test the maximum range, and particularly to find whether such waves would carry over the horizon, and whether there would then be a rapid falling off of strength. Permission was kindly given for a test to be made on the Dublin Steam Packet Company's boats running from Holyhead to Kingston, and this was done in June, 1920. During this test, speech was received right into Kingstown Harbour, 70 nautical miles from Carnarvon, and the point was proved that there was no rapid diminution of strength after passing the horizon line from Carnarvon.

As a result of these experiments it was decided to test the range of a short-wave reflector system wholly over land. A site was chosen at Hendon, and a reflector and transmitter for 15-metre waves erected with the reflector pointing towards Birmingham. Tests were commenced in February, 1921, from Hendon to a portable receiver on a motor car. Very good speech was received up to 66 miles, and fair speech in the neighbourhood of Birmingham. A reflector station was then erected at Frankley, near Birmingham, 97 miles from Hendon, and tests were started there in August, 1921. The following are some particulars of the Hendon and Birmingham plant :—

Fig. 2 shows a photograph of transmitter and receiver.

The transmitter consists of two medium-size power valves working in parallel. The power to the valves is usually 700 watts (4,000 volts, 175 mA). The aerial is rather longer than half a wavelength, and has a radiation resistance of the order of 90 ohms. The efficiency, input to valves to aerial power, is between 50 and 60 per cent., and about 300 watts are actually radiated. With the reflectors up at both ends speech is strong, and of very good quality. It is usually strong enough to be just audible with a $\frac{1}{4}$ to $\frac{1}{2}$ ohm shunt across a 60-ohm telephone.

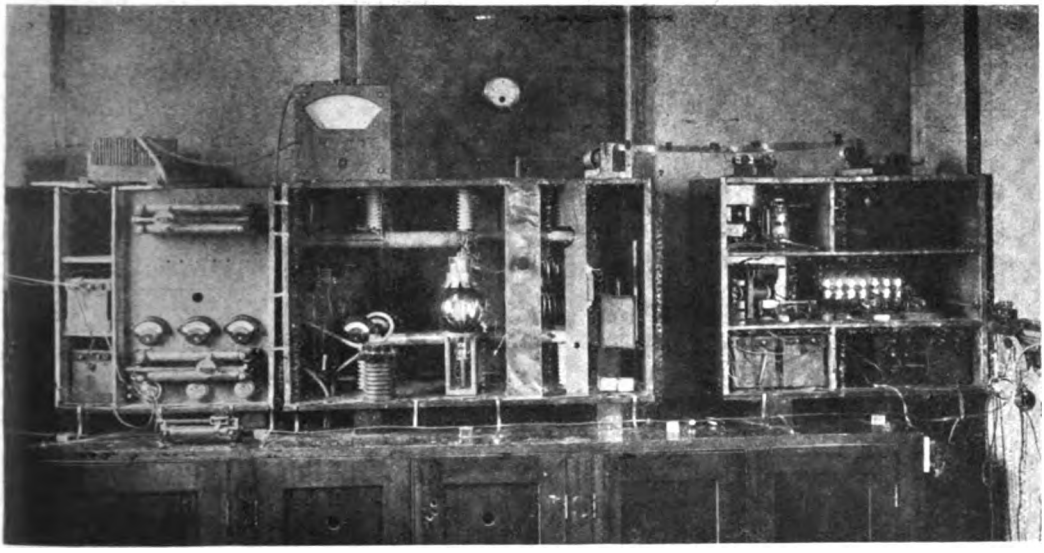

*Fig. 2. Transmitter and Receiver of the type used at Hendon and Birmingham.*

With both reflectors down the speech is usually only just audible with no shunt. Average measurements indicate that the energy received when both reflectors are up is about 200 times the energy received when not using the reflectors. Thus to get the same strength without reflectors as with them a 140-kW valve transmitter of the same efficiency would be required. Local measurements of the polar curves taken round the station show that the electric field in front of the station is increased approximately 4 times by the use of the reflector, and that the same order of increase is obtained during reception : the increase of energy received due to the use of the two reflectors should therefore be $4^2 \times 4^2$ 256 times.

Fig. 3 shows a measured polar curve of the electric field of Hendon station taken locally. It

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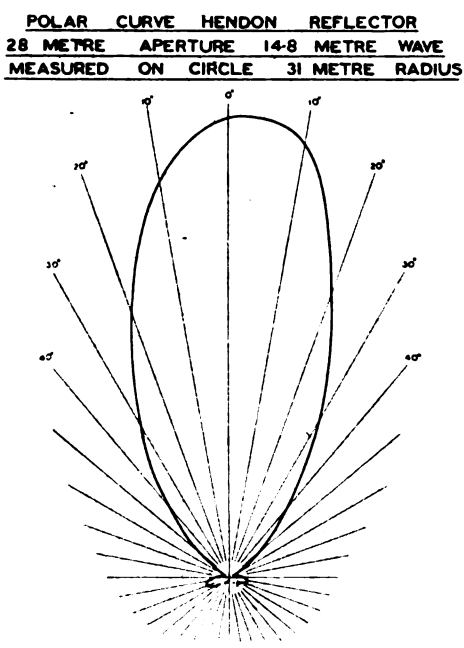


*Fig.* 3.

is rather unsymmetrical owing, it is thought, to the ground being on a slope, and perhaps to local reflections from trees and wires.

It has been suggested that a polar curve taken locally round the station is not the same as the polar curve at a distance, and that the directional effect is soon lost. The author does not agree with this. It has therefore been planned to measure the range of Hendon and Birmingham in different directions, but this has not yet been done. The fact that by using reflectors the energy received at these stations is increased some 200 times, is, the author considers, a proof that the directional effect does persist. It is, however, essential that the stations should be in situations free from obstacles which might cause powerful local reflections and distort the field. Experiments made with revolving reflectors, where it is comparatively easy to make measurements at any distance, also prove that the polar curve is practically constant at all ranges.

The production of waves of the order of about 12 metres and upwards is quite practicable up to several kilowatts by large power valves, and it is also practicable to operate valves in parallel. With such high frequencies very large currents pass into the grid and anode; the seals through the glass must, therefore, be large. The production of a reliable transmitting valve entailed a large amount of work, and the great dissimilarity of results from apparently similar valves was very puzzling for some time. In a new batch of valves the efficiency at 15-metre wave would vary from about 60 per

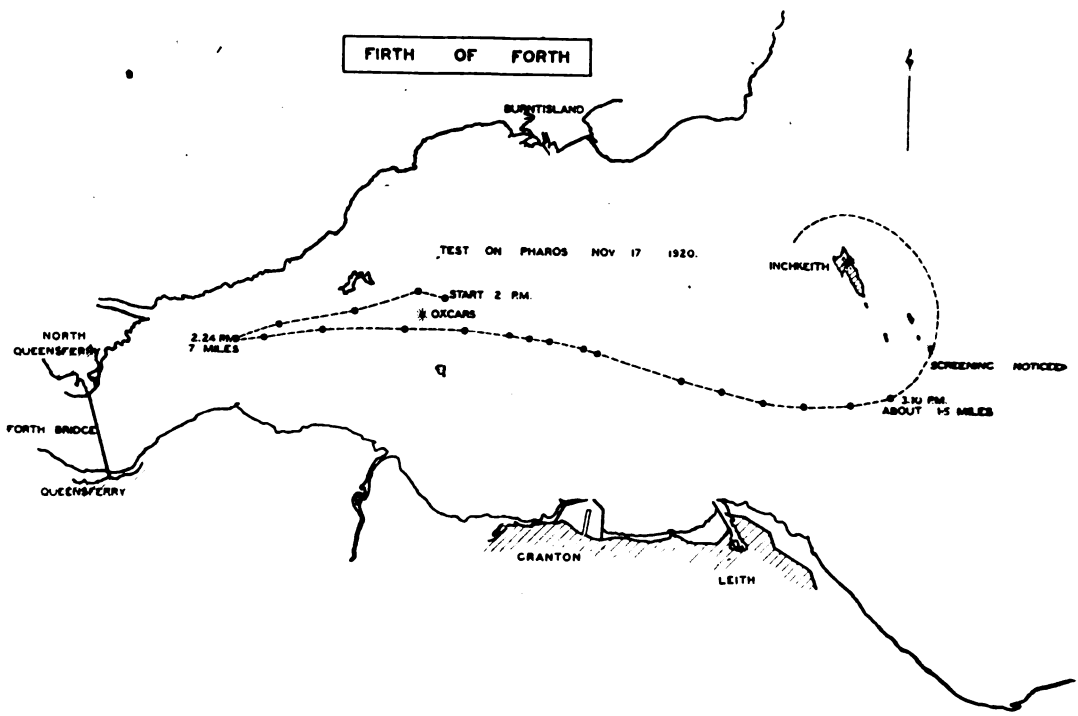


*Fig.* 4. *Chart of the course of the s.s.* "*Pharos.*"

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cent. down to 5 per cent., and if any attempt was made to push up the power on a bad valve the glass would promptly melt at some spot. The cause of the trouble has been found to be due to losses in the deposits on the glass, owing to high-frequency currents induced. Such deposits are always produced in valves during exhaustion, and vary considerably.

If a number of valves are laid successively between the plates of a small air condenser in a very high-frequency field of the order of 20,000,000 per sec. (without making any connections to the valves), the results are quite remarkable. Some

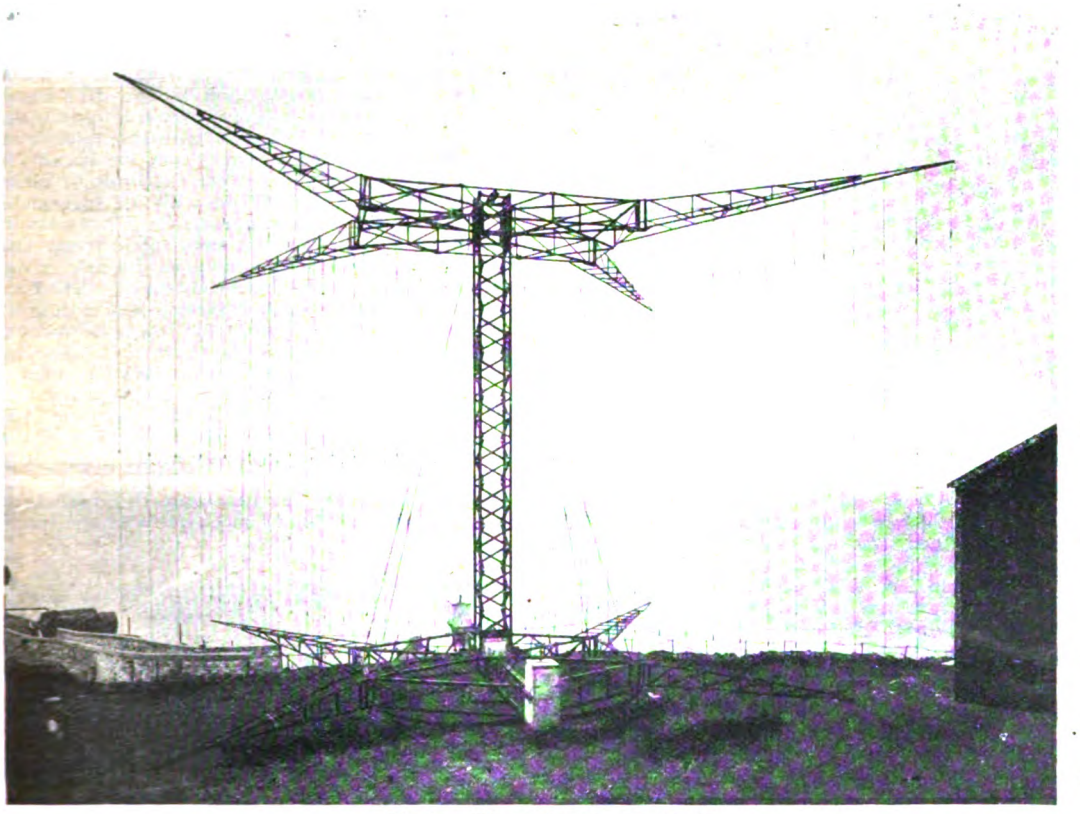

*Fig. 5. The Reflector at Inchkeith.*

produce no appreciable effect, while others at once put a big lead on the circuit, and if 200 to 200 watts of high-frequency energy are available, the glass gets hot and will quickly melt at some spot. One of my assistants, Mr. E. Green, made a useful discovery which overcomes this difficulty and it is now therefore possible to use what are practically standard valves, and their life appears to be about the same as for lower frequencies.

During the continuous-wave tests at Carnarvon it was found that reception was quite possible on the transmitting aerial while the transmitter was operating. This has been used successfully for duplexing between Hendon and Birmingham, and eliminates all switching.

The heterodyne may be either the transmitter, or an independent small heterodyne in the receiver. Both the transmission and the reception utilise the same aerial and reflector, and the transmitter is left going and can be operated while receiving.

There is no reduction in strength while the transmitter is on, but a practical trouble has appeared. Owing to the comparatively large power, strong currents are induced in all conducting structures and circuits close to the reflector and transmitter, such as the supporting towers and buildings, and every variable contact produces a noise. The elimination of all variable contacts in the neighbourhood of the transmitter has proved a work of some magnitude.

Reflectors besides giving directional working, and economising power, are showing another unexpected advantage, which is probably common to all sharply directional systems. It has been noted that practically no distortion of speech occurs, such as is sometimes found with non-directional transmitters and receivers.

Although the results between Hendon and Birmingham constitute a record for telephony for

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the wavelength—for such results were believed to be impossible two years ago—they are only a first attempt and do not represent the best that can now be done after the experience gained. Birmingham, it is interesting to note, is 10,400 wavelengths from Hendon.

It has thus been demonstrated that wavelengths of the order of 20 metres are quite capable of providing point-to-point directional commercial service

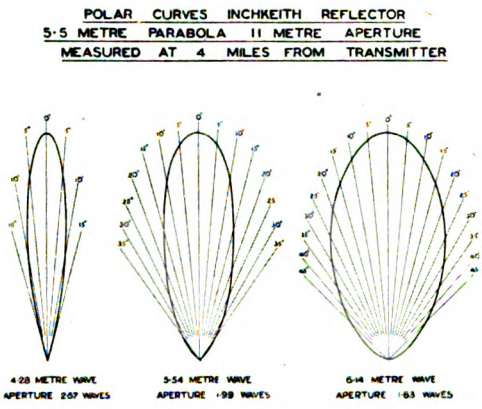


*Fig. 6.*

over very considerable ranges. Such services will be comparatively secret as compared with the usual non-directional type of transmission.

The directional effect obtained with reflectors which are large compared with the wavelength, is so good that it was suggested that it would prove very useful for position finding for ships near dangerous points. Through the courtesy of Messrs. D. & C. Stevenson, Consulting Engineers to the Northern Lights, and the Commissioners of the Northern Lights, trials are being made with a revolving reflector erected on Inchkeith Island. Credit is due to the author's assistant, Mr. N. Wells, who has been superintending this work on the island—very often under strenuous conditions.

The general idea is that a transmitter and reflector revolving will act as a kind of wireless lighthouse. It is not intended at present for long ranges, but rather that revolving reflectors should be erected in position, similar to those at present occupied by fog signals, and be capable of similar ranges, so as to give the position to ships during fog when within about 10 miles of the danger point.

An experimental revolving reflector was erected on Inchkeith, and tests were made to s.s. "Pharos," the lighthouse tender of the Northern Lights Commissioners, during the autumn of 1920. With a 4-metre wave, spark transmitter, a reflector of 8 metres' aperture, and a single valve receiver on the ship, a working range of 7 nautical miles was obtained. The reflector made a complete revolution once every two minutes, and a distinctive signal was sent every half-point of the compass. It was found that this enabled the bearing of the transmitter to be determined within ¼ point of the compass, or within 2·8 degrees. Fig. 4 shows a chart of the course of the s.s. "Pharos."

These results were good, but it was desired to know the effect of putting the transmitter lower down at the point of the island where ships would pass quite near. A new and larger reflector was designed, and erection has just been completed.

Fig. 5 is a photograph of the reflector at Inchkeith.

Fig. 6 shows polar curves taken with reflector.

This latter figure gives measured polar curves taken recently with the new reflector, and illustrates very well how the beam sharpens up with large ratio of reflector aperture to wavelength. The curves were measured at a distance of 4 miles.

The best method of giving the direction to a ship by means of such a revolving beam requires consideration. The method being adopted is, the author thinks, the most practical one. When listening in a receiver to a moderately sharp revolving beam the signals are heard only for a very short time. Taking the case of such a beam shown in Fig. 6 as produced by the 4·28-metre wave: supposing it makes a complete revolution in one minute, then at 4 miles with the receiver at maximum sensitiveness signals will be heard for 7 seconds every minute. Near the limit of range signals will be heard for only about 4 seconds. The exact time of maximum signals is not easy to determine by ear, but the times of starting and vanishing are easy to determine, as the rate of rise and fall of the signals is extremely rapid. The time half-way between these two times gives with great exactness the moment when the beam is pointing to the ship.

It would be quite possible to arrange to send a general broadcast signal when the beam passes through true north; then by arranging for the beam to revolve at a perfectly uniform rate, the bearing on the ship could easily be determined by means of a stop-watch. This method is probably the most accurate, but has some disadvantages. It entails accurate timing mechanism at the trans-

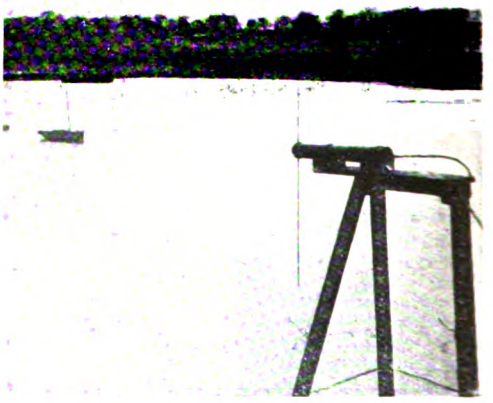

*Fig. 7.*

*One of the two short-wave receivers.*

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mitter ; the use of two waves : and three, or perhaps four receivers on the ship, as well as the use of a stop-watch.

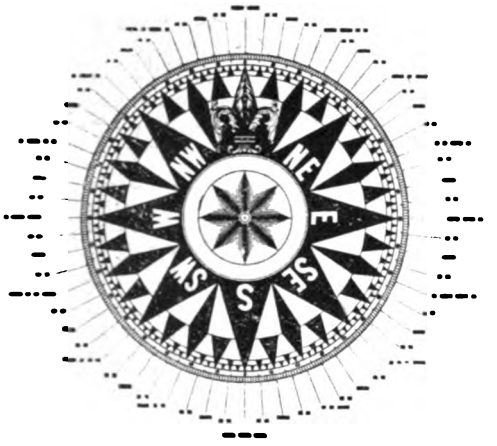


*Fig.* 8.

For the short wave two receivers are required, one at each end of the bridge, or one fore and one aft. One of these is shown in Fig. 7. This is necessary to avoid screening by the ship itself. If the broadcast wave for giving the time when the beam passes true north is another short wave, then two more receivers would be required.

The method provisionally adopted avoids accurate timing mechanism at the transmitter and the use of a broadcast wave, also the use of additional receivers and a stop-watch. On the base of the revolving reflector contact-segments are arranged so that a definite signal is transmitted every half or quarter-point of the compass. A distinctive letter is sent every two points and short signs mark the intermediate points and half-points. When listening-in at the receiver a few short signs are heard and one or two letters. The letters and signs used are shown on the card (Fig. 8). If the letters *t* (—) *i* ( · ·) *o* (— — —) *i* ( · ·) *t* (—) *i* (· ·) are heard :

By reference to the card shown in Fig. 8, the half-way position is between South and S. ½ West and the bearing to the transmitter will be S. ¼ W.

The apparatus proposed is of a very reliable nature. The spark transmitters are very robust, and last for years without attention. The receivers are simple valve rectifiers with fixed adjustments except for a "backing off" potentiometer for dealing with powerful signals at close range. The attenuation of these waves over sea is so strong that a little experience enables distance to be judged by strength of signals, and this can be measured by means of the potentiometer. The only qualification necessary for a person determining the bearing, is the ability to read a few Morse signs.

In conclusion, it is thought that enough has been done to show that short-wave directional wireless telegraphy is likely to be very useful in the future, and the results just described should lead the way to more extended researches.

The names of some of those who have been directly associated with these experiments have already been mentioned, and the author has to acknowledge the large amount of help and assistance derived from the advice and researches of many others.

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# Wireless Telephone Broadcasting in America

## UNITED STATES GOVERNMENT REGULATIONS FOR CONTROL

THE final report of a Radio Telephonic Committee appointed in connection with the recent Department of Commerce Conference on Radio Telephony, in Washington, has now been made public. The committee recommended that an advisory committee to the Secretary of Commerce be appointed, to consist of not more than twelve members, six in the Government and six from outside.

Recommendations were made as to wavelength allocation by classes, giving the amateur the band between 150 and 275 metres, and suggesting the assignment of specific wavelengths to each broadcasting station, except those operated by the Government, within the bands designated for such use. Experiencing great difficulty in providing even part of the general service demanded, the conference disapproved of the introduction of direct advertising at the expense of essential communication.

In connection with technical methods intended to prevent and reduce interference, authority to prevent unnecessary interference was sought, and it was suggested that the Bureau of Standards should make a special study of operating difficulties, ranges, width of wave bands, etc.

With the report in its final form, a legal subcommittee is now preparing a bill intended to give the Government authority to establish and enforce regulations, which will shortly be introduced in both houses of Congress, and, it is hoped, rushed through. The Committee, headed by Dr. S. W. Stratton, Director of the Bureau of Standards, and including members of Army, Naval, scientific, commercial, and amateur communication and radio interests, recommend that the Secretary of Commerce be vested with authority to control the establishment of all radio transmitting stations except amateur, experimental and Government stations, and the operation of non-Government

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transmitting stations, all receiving stations being excepted. The Committee also passed a resolution to the effect that the types of radio apparatus found most effective in reducing interference be made available to the public without restriction.

### ALLOCATION OF WAVE BANDS.

The assignment of 22 wave bands for radio telephony was made as follows: Transoceanic experiments, non-exclusive, 5,000-6,000 metres; Fixed service, 2,850-3,300; Mobile service, non-exclusive, 2,500-2,650; Government broadcasting, non-exclusive, 1,850-2,050; Fixed station, non-exclusive, 1,550-1,650; Aircraft radio telephony and telegraphy, exclusive, 1,500-1,550; Government and public broadcasting, non-exclusive, 1,050-1,500; Radio beacons, exclusive, 950-1,050; Aircraft radio telephony and telegraphy, exclusive, 850-950; Radio compass service, exclusive, 750-850; Government and public broadcasting, 200 miles or more from the seacoast, exclusive, 700-750; Government and public broadcasting, 400 miles or more from the seacoast, exclusive, 650-700; Marine radio telephony, non-exclusive, 650-750; Marine telegraphy, exclusive, 525-650; Aircraft radio telephony and telegraphy, exclusive, 500-525; Government and public broadcasting, exclusive, 484-495; Private and toll broadcasting, 285-485; Restricted, special amateur radio telegraphy, to overcome barriers, non-exclusive, 310; City and State public safety broadcasting, exclusive, 275-285; Technical and training schools (shared with amateur), 200-275; Amateur telegraphy and telephony (exclusive, 150-200 metres) (shared with technical and training schools, 200-275 metres), 150-275; Private and toll broadcasting, exclusive, 100-150; Reserved, all below 100.

### WHAT IS BROADCASTING?

To clear up certain difficulties due to lack of definitions, the Committee defined Government broadcasting as that done by departments of the Government: Public broadcasting, that carried on by public institutions, universities, and such stations as are licensed to disseminate information and educational service; Private broadcasting, signifying broadcasting without charge, by a station owner, communication company, store, newspaper, organization or individual licensed to disseminate news, entertainment and other service; and Toll broadcasting, where a charge is made for the use of the transmitting station.

Private detective agencies desiring to operate radio telephone broadcasting stations, it was recommended, should be required to co-operate with municipal or state services in the use of the wave band 275-285.

In view of public demand for broadcasting, it was not deemed desirable to send messages over wide areas for point-to-point communication, except where communication could not be effected by other means. It was recommended that for this purpose other means should be used. An immediate study of geographical distribution of broadcasting stations was urged to secure the best service with minimum interference. Where congestion of radio broadcasting existed, it was recommended that the Secretary of Commerce should assign suitable hours of operation to stations. When conflict of transmissions occurs, consideration for the public not otherwise reached was recommended, and the priority of stations was established as Government, Public, Private and Toll.

### NO ADVERTISING.

Direct advertising by radio broadcasting was prohibited and indirect advertising limited to the statement of the station's call letters and the name of the concern responsible for the matter broadcasted.

Recommendations that the transmission of signals tending deliberately to interfere with the reception of official time signals, constitute grounds for the suspension or revocation of a license were advocated in the report. Licenses for operators of radio telephone transmitting stations, should also require a knowledge of receiving and transmitting apparatus and the International Morse Code sufficient to receive at a rate of not less than ten words per minute.

It was agreed that the operation of Government stations be conducted in such a manner as not to interfere with the commercial traffic and broadcasting, and that whenever Government-owned stations were used for the transmission of commercial traffic and broadcasting, they should conform to the regulations established by the Secretary of Commerce.

### RECOMMENDATIONS RELATIVE TO AMATEURS.

The final report recommended that the status of the amateur be established by law and that the limits of the wave band allotted to the amateur as given above (150-275 metres) be specified in the law, and that the amateur continue to be under the jurisdiction of the Department of Commerce.

For the purpose of self-policing among the amateurs, the creation of amateur Deputy Radio Inspectors, elected from their number in each locality, was approved; that upon receipt of notice of such election the Radio Inspector in charge of the district appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year; that the duty of such amateur Deputy Inspector should be to endeavour to the best of his ability to accomplish, under the direction of the District Radio Inspector, observance of the Radio Communication Laws and the Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such Amateur Deputy Inspectors be clothed with whatever authority might be necessary in the opinion of the District Radio Inspector.

It was also recommended that the waves assigned to amateurs, between 150-275 metres, be divided into bands according to the method of transmission; damped wave stations being assigned the band of lowest wavelengths, interrupted or modulated continuous wave radio telegraph stations the next band; radio telephone stations the next band, and finally unmodulated, continuous wave radio telegraph stations the band of highest wavelengths. That amateurs be permitted to carry on broadcasting within the wavelength band assigned by-

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the Secretary of Commerce to amateur radio telephony, was recommended.

NEARLY 19,000 TRANSMITTING STATIONS.

Within a few days the Department of Commerce will have issued its 19,000th transmitting license. To-day there are 18,894 stations of various classes entitled to transmit radio signals.

On April 28th, the number of amateurs licensed and listed in their nine districts was 15,061, but as these reports come in only monthly, the number has probably already passed 16,000. A survey of all broadcasting licenses gives a total of 212, the number of which is increasing daily.

The balance of the stations are, of course, commercial, ship and special stations, which do not increase as fast as the amateur and the popular broadcasting stations.

Between April 23rd and 27th, twenty licenses were issued, among them there were three universities, two newspapers, a church and a police department.

# Listening In

By J. E. WILKES.

NOWADAYS one can read *ad infinitum* about valve circuits, high and low frequency amplification and valves of all types; but one rarely sees an account of actual results. I propose, therefore, to write a little of what I actually get on my apparatus in the hope that others will be prompted to do the same; it is best to compare results and in that way to select the most suitable apparatus for one's particular requirements.

At the outset, I will detail the sets I have in use at the present time.

The basis of most of my work is a C Mark III amplifier. At first this must sound strange; but the amplifier is fitted with a panel just in the space occupied of old by the H.T. battery; on the panel I have fitted a separate rectifying valve, but above all a perikon detector mounted inside a rubber tube. Alongside I keep a separate heterodyning valve.

The coils to supply all sets are of the honeycomb type for all wavelengths above 600 metres; for and below that, I use spider webs.

With the foregoing apparatus I can read all ordinary spark and C.W. stations. For example: Supposing I want to check my chronometer by the 1655 G.M.T. time signals from Annapolis, as I do each evening. First I switch in my largest coils; then I plug in my crystal set and switch on the separate heterodyne; following this, I put all of the 4-volt current through the filament of the amplifier, but only 15 volts on the plates; in this way Annapolis comes in quieter and far more clearly than by using any valve as a detector.

A further example may serve to show the convenience of this apparatus. Let us assume that we want to get the ships on 600; all the change necessary is to switch off the separate heterodyne; switch in the spider coils; increase the plate current to 60 volts and reduce the filament current; then the ships come rattling in.

The above set gives me the following interesting items: On C.W. I get all big stations from Panama to Cairo; the most interesting are Sayville press; Annapolis time; occassional American news despatches; Rome press; Hanover-American news despatches; Bordeaux press; Helsingfors press; sometimes, but never unless hard pressed, I read the Leafield press; this usually brings on refreshing sleep.

Several of the foregoing stations are usually read on crystal only, with the aid, of course, of a separate heterodyning valve; there is no more certain way.

On the spark I get Moscow, Coltano, Malta, Nauen and hosts of ship and shore stations.

In telephony I get with ease Croydon, Paris and one or two more, but the set fails singularly to bring in our dear old friend, the Dutch Concert, or any of the land stations or planes on the London-Paris air route, excepting Croydon.

For the latter class of work, and for all other kinds of delicate work, I use a six-valve high frequency set. This has interchangeable transformers, and of course, a separate heterodyne. The switching arrangements are such as to enable any number of valves to be put in use. In fact, a single valve can be used, self-heterodyned.

For very delicate long distance work, this set is used as follows: First of all the station is tuned in to oscillate with reaction; coil reaction oscillation is then stopped by loosening the coupling; next the set is made to oscillate with the separate heterodyne and tuned to the exact note obtained originally. Now the reaction coil is brought back very gingerly to nearly its original position. The most careful adjustment will produce extraordinarily clear loud signals and no other method of work will give the same selectivity. The one drawback is the length of time required to get everything in perfect tune, and to keep it there with ever-changing currents.

For telephony, of course, the six valve set is *it*, *par excellence*. For instance, if only three valves are used, and the result sent to a loud speaker *via* the C Mark III amplifier, the Dutch Concert can be heard easily 50 yards away. I regret to say that some of our people insisted on dancing to the music last Sunday afternoon.

The distortion caused by the loud speaker is very bad, however, and it is far preferable to use the telephones, especially for speech.

Wireless to me is literature, music, society, and, as before hinted, occasionally narcotic. I have tried to sketch the means by which I have "got there" after several years of experiment. I know others do better. Will they be so good as to tell us of their methods and what they get too?

B

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# The Mechanical Design of Switches for Inductances

By J. R. HOULT.

*Member of the Manchester Wireless Society.*

IN designing switches for use with Inductances there are several requirements which must be taken into account, namely, robust construction, lengthy service, freedom from capacity effects and smooth working.

The necessity for robust construction will, of course, be obvious, and with robust construction lengthy service is closely allied. It does not follow that a strong switch will always give lengthy service; it may grind itself to pieces with constant wear, or again, it may be so strong that the blades tend to jam when passing successive contacts.

Freedom from capacity effects is more a matter of carefully considering the circuit in which the switch is to be used. In a plain inductance circuit, as Fig. 1, it will be found that the switch should

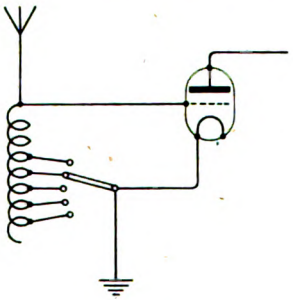


*Fig.* 1.

be placed in the earth lead as shown; if this is done the capacity effect of the hand when making adjustments will be found to be at a minimum. There are, however, circuits in which the switch would be desirable at the grid end of the inductance, and here we have to make allowance in the design of the switch. In the switch to be described the writer has arranged a fairly small knob at a good distance from the front of the panel, an arrangement which gives good service in practice.

Smooth working of a switch is, generally speaking, the result of careful "bedding" of the blades and a consideration of the ratio of the diameter of the contacts to the distance between them.

In the photos Figs. 2 and 3, the type of switch favoured by the writer is seen attached to an inductance former of shellaced cardboard. It will be noticed that the stop pins are used to support the inductance former; this allows the whole inductance and switch, as a unit, to be removed from its case. This type of construction, which is becoming widely recognised as a standard arrangement, is strongly recommended by the writer, since any adjustments are easily carried out, and in the case of inductances like that shown, it will be seen that the length of the wire required for tappings is reduced to an absolute minimum. This is not only desirable from the cost point of view, but also from the more important one of capacity effect, as it will be seen that if the former was independent of the switch and fixed in a case with the switch base as a sort of lid, its tappings would have to be much longer in order that there would have to be sufficient room to solder up the connections. When the "lid" was put on, the tappings would be twisted and crumpled between the

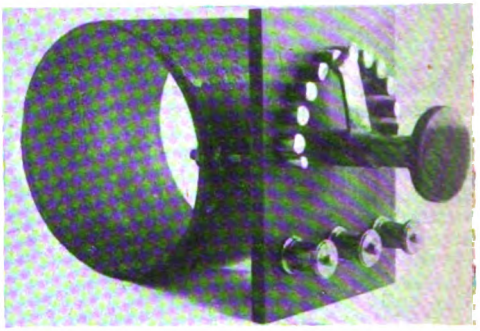


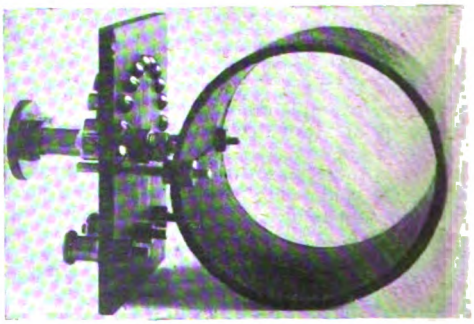
*Fig.* 2.

former and the switch base, and the resulting path for the H.F. currents would be anything but straight.

The dimensions of the switch are given in Figs. 4, 5 and 6. The dimensions of the base should be made to suit the cabinet or box in which the switch will be fitted.

It will be seen that the switch consists of a spindle A with a milled knob, carrying the blades C and a bush B for the ebonite base.

The threaded part of the bush, which is shown



*Fig,* 3.

as 7/16 of an inch long and having 26 threads per inch, is one of the important points to notice. This length decides the maximum thickness of

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base on which the switch can be used. In future switches the writer will increase this length to 9/16 of an inch (with a corresponding increase in the length of spindle "A") in order to accommodate bases up to ⅜ of an inch thick. If a thinner base is used the bush is not cut down, as the extra part sticking through does not interfere with the working of the switch. The method of attaching the blades to the spindle is shown at D. The hole in the blades is a tight fit over the spindle, and the two blades are pushed up tight to the shoulder and two small holes drilled. Small brass wire pegs are then hammered in and filed off flush with the underside of the blades. The method of fastening the spindle in the bush so that the nut will not work loose is shown at E. A 6 B.A. hole is

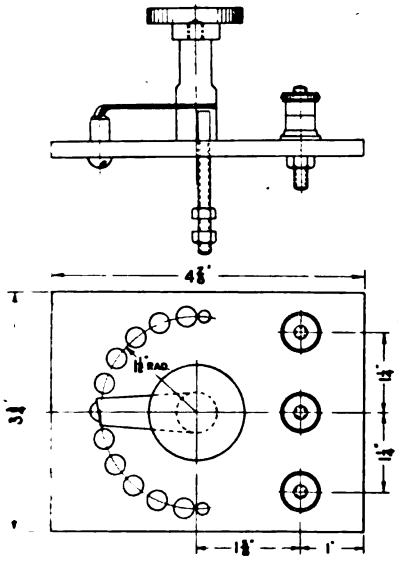


*Fig.* 4.

tapped into the spindle (in the part marked 3/16 of an inch Whit in sketch A), and a screw and washer is placed over the nut as shown to keep the nut from working loose. A spring washer is placed under the same nut to keep the blades hard down on the contacts.

The whole switch is made of brass with phosphor bronze blades and ebonite knob and base.

The stop pins are shown at F (Fig. 6), and require no explanation except that the base is tapped to receive them, as there is not room for a nut at the back.

The contacts themselves are a decided advantage over the commercial type where the stem is turned down from the contact diameter as they cost considerably less and they can be used for *any* thickness of base, the varying factor being the round-headed screw which can be bought in almost any length. The tappings are soldered on to the heads of the screw by the writer, but in temporary switches they can be placed directly under the screw head and tightened up.

With regard to assembly and bedding. The contacts are first mounted and well tightened. A file should be placed over as many contacts as possible and well rubbed to ensure that all contacts are the same height; this process should

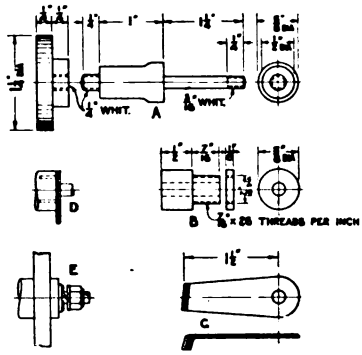


*Fig.* 5.

be repeated with a piece of emery cloth over the file to give a smooth surface. Next place the bush in position, and, finally, the switch. When the switch is tightened up and the 6 B.A. screw got into position a piece of emery cloth should be placed face *up* over a few contacts and the switch arm run over it; rub the switch to and fro several times to bed the blades parallel to the contact faces. The edges of the blades then need carefully rounding.

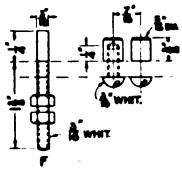


*Fig.* 6.

It will be noticed that the blades are not bent over squarely, but at a slight angle. This is an important factor to the successful working of the switch as it makes the contacts self-cleaning and greatly assists the smooth working of the switch. It will be seen that a slight scraping action takes place, and to assist this a trace of oil should be rubbed over the surface of the contacts.

In conclusion it might be mentioned that the writer has had several of these switches in constant use for a period of three years, no adjustments of any kind having been found necessary.

## The Reinartz Tuner.

Mr. Harris points out to us that in the diagrams of his article on the Reinartz Tuner there are two slight errors. In the diagram of connections on page 190 the aerial tappings are numbered 2, 4, 5, 6, 7, 8 and 9. Actually they should be numbered 10, 8, 6, 5, 4, 3, 2 and 1. In the constructional drawing on page 193 the tenth tapping of the aerial circuit should be connected to the central filament terminal. Both of these points were made clear in the text.

B 2

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# Four-Electrode Valves and their Circuits

By CAPT. H. DE A. DONISTHORPE.

(*Continued from p.* 201.)

**The President**

I believe Mr. Scott-Taggart wishes to speak; I will ask him to continue the discussion.

**Mr. J. Scott-Taggart.**

Before describing one or two special kinds of valve which I have designed myself, I would like to make a few comments on the paper which we have just heard.

Personally, I am not a great enthusiast where special kinds of valves are concerned. The valve which has been described to-night is a complicated structure containing a filament, two grids and an anode, and this valve is intended to enable us to obtain high frequency amplification, with a stage of rectification and a stage of low frequency amplification. We have noted from the diagram that we have seen to-night that the different elements used, such as inductances and transformers, are of the kind used in an ordinary receiving set, and it seems to me that very little is gained by making a complicated valve having a plurality of electrodes instead of using the ordinary collection of two or three standard three-electrode valves. We do not benefit by having fewer component parts. The only way in which we derive any benefit is that we can use a single valve instead of, say, two or three three-electrode valves, and all those who have had any experience in the construction of thermionic valves will, I think, agree with me when I say that to make the four-electrode valve that has been described to-night, necessitates as much time and trouble as two or three standard types of valve which are made in very large quantities, so that it always seems to me that with these special types of valves (freak valves, we may call them), unless they produce some entirely new effect, we are complicating the problem of receiving wireless signals. We are trying to produce a compact set in a roundabout way which gives neither improved results nor cheaper manufacture. The disadvantage, moreover, of trying to combine everything into a single valve is that the circuit tends to oscillate much more readily, and adjustments are more critical than in the simple case with two or three valve receivers. I have not dealt with the question of saving in valves. I doubt very much whether anything at all is saved on it, because three-electrode valves are made in thousands and can be made fairly cheaply, whereas a special valve with two grids complicates the construction very greatly and is an expensive proposition. Then again, in the construction of these valves there is a tendency to a greater loss due to non-uniformity, the different swings. It is bad enough to construct uniformly two or three-electrode valves, so that when we make an addition to it we complicate the problem still further.

Then again, turning to the question of the amount of amplification we get by a valve of this kind. It has been said that you get an amplification equivalent to three ordinary valves, but I am doubtful whether that is so, because in the first place it is a well accepted fact that a valve cannot carry out all three functions at the same time to the best effect; it is better to allow a valve to amplify high frequency or low frequency at a single stage, and to use different valves for the different subsequent stages, so that once you begin to do all these things with a single valve, you are liable to produce complications which are disadvantageous. To use the valve as shown us, you get a stage of high frequency amplification, and you get a stage of rectification which is inefficient. What you are doing is to use a Fleming valve as a rectifier and a Fleming valve is really no better than a crystal detector; then you take the rectified currents from this Fleming valve rectifier and amplify them at low frequency, so what you are doing is equivalent to a stage of high frequency amplification, followed by a crystal detector and a stage of low frequency amplification. When you are using three three-electrode valves, you get a stage of high frequency amplification, a stage rectification which may be three or more times as sensitive as a two-electrode valve and then a three-electrode valve is used as an amplifier. And you can use all these valves to the best advantage whether it be as rectifier, high frequency or low frequency amplifier.

There is another point which I wish to mention in connection with the circuit. I noticed in Fig. 7 two points; one was that the transformer which passes back the low frequency current for low amplification is connected at the grid end of the inductance. I would be very pleased if the author of this paper could explain the reason for putting the transformer at the grid end instead of at the filament end, because generally speaking it is good practice, and the best practice, to place a piece of apparatus such as a transformer or battery at a point of earth potential and not at a point in the circuit which is at high frequency potential to earth. There is also, I notice, no grid condenser connected across the grid winding of the low frequency transformer.

Coming to the valves which I have designed myself, possibly the same objections might be raised against them. It is questionable whether any of these freak valves have any merit over the ordinary three-electrode valve. Of course, you are open to get a certain advantage over the single three-electrode valve, but I think in general it is preferable to keep to a pair or three ordinary three-electrode tubes instead of trying to complicate matters by putting all the electrodes into one tube. Of course, if you get some entirely new scheme which cannot be resolved into three-electrode tubes, well and good; something new is produced. But if you are going to produce the old effect in a more complicated manner, it is better to stick to the ordinary methods of reception.

I have brought along a few slides which I have

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sketched out, and I hope they will come out sufficiently clearly to be seen.

Fig. 9 illustrates a four-electrode valve of a kind already described by Mr. Donisthorpe. Two grids, $G_1$ and $G_2$ are used and these grids both apply high frequency potentials which vary the electronic current flowing from the filament to the anode A. The incoming signals set up oscillations in $L_1$ and $C_1$, and these oscillations are applied to $G_1$ and produce amplified oscillations in the anode circuit of the valve. We have the anode A, a tuned oscillatory circuit $L_2$ $C_2$, the telephones T, and the

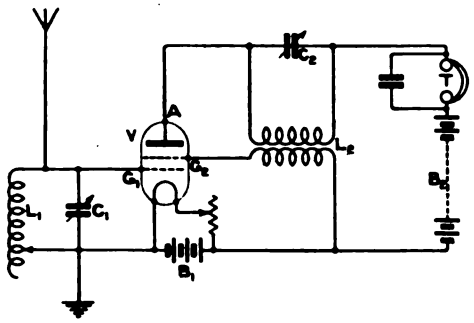


*Fig. 9.*

anode battery which is below. Now, if we examine that circuit to start with, we will see that when signals are being received, the oscillations are amplified by the valve, and produce amplified currents in $L_2$ and $C_2$, and these amplified currents are now rectified by the valve, and also amplified, and I do that by connecting the grid coil $L_3$ across the grid $G_2$ and couple it to the coil $L_2$. Now, when we are receiving wireless signals, we get the magnified oscillations in $L_2$ $C_2$ passed on to the grid coil $L_3$, and applied to the second grid $G_2$ where they are rectified. This can be done either by putting a leaky grid condenser in the $G_2$ grid circuit, or simply by relying on grid damping to lessen the positive half-cycles, and so produce a rectification effect. Now these oscillations applied by $L_3$ to the grid will give a rectified current in the anode circuit, and we therefore get in the anode circuit not only magnified high-frequency oscillations which are passed through $L_2$ $C_2$, but also rectified low frequency currents, which pass through the telephones T. The advantage of the circuit is that we can get reaction effects and also high frequency amplification and detection, the detection being accompanied by low frequency amplification, although no transformer is shown in the particular example I have shown. The coupling between the coils at $L_2$ is such that there is a reaction effect between these two coils, and if the coils are coupled sufficiently tightly, continuous oscillations will be set up in the circuit $L_2$ $C_2$ and by tuning $L_2$ $C_2$ to a frequency slightly different to the frequency of incoming continuous wave signals, beats will be produced in the circuit, and these beats will be rectified by the valve and will produce signals in the telephones.

The advantage of this circuit is obtained chiefly when receiving continuous waves, and an additional advantage is that the oscillations are not produced actually in the aerial circuit as in the usual form of continuous wave receiver, but in a circuit to the right of the valve, so that the valve really acts as a trap which allows incoming continuous wave signals to be applied to the grid, but does not allow the local oscillations to get back to the aerial circuit. It is difficult to prevent a certain amount getting back, but the amount would be very small and negligible in comparison with the amount which gets back in the case of the usual self-heterodyne circuit.

The second type of valve is one which is becoming important commercially, and is fitted to a large number of steamers including the new Cunard vessel "Berengaria," and it is called the "Negatron." Some of you may have read about it in the *Radio Review*. It is a form of valve having four electrodes, but working on a different principle to any of the other kinds of valves which have been shown here. I have two anodes which take the form of flat plates, and which are marked A and B one on each side of the filament, a grid being placed between the filament and anode B (Fig. 10). This grid is usually in the form of an ordinary piece of wire not in the form of a mesh, and the circuit which is used in connection with it for demonstrating the action of the tube is given in Fig. 11. The object of this valve is essentially to produce a negative resistance effect. You all know the nature of a negative resistance characteristic and that the current curve slopes down, and that as we increase the voltage applied to a conductor the current decreases, and it is also a well-known fact that any negative resistance device, if applied to a circuit having ordinary resistance, will neutralise the resistance, and if we connect an oscillatory circuit in a negative resistance device we can produce continuous oscillations, which may be used for transmission or for any other purpose, so that negative resistance devices are very important. In Fig. 11 we have two anodes A and B, as shown in Fig. 10. In the A circuit we have a battery about 60 volts and a milliammeter M. The anode is connected to the grid through a battery $B_4$, which is put there to give the grid G a voltage about zero, otherwise it would have a high positive potential. The anode B is connected to a high tension battery $B_3$, also of about 60 volts. The action of the arrangement is briefly this:—By adjusting the filament current, I arrange that the

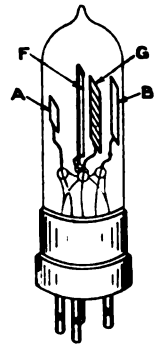


*Fig. 10.*

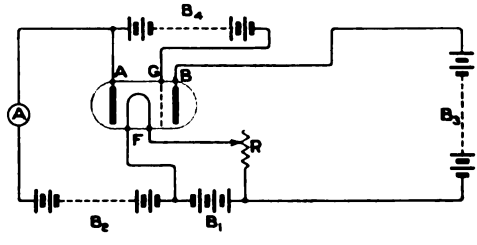


*Fig. 11.*

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electrons from the filament all go to one or other of the two anodes. Now, when such are the conditions, if we increase the number of electrons passing to one anode, we must take away electrons which are going on to the other anode, because there is only a limited supply; if one anode takes more the other must take less. Now, if we suppose that the voltage of $B_2$ is increased, the voltage of the anode A is increased. In the ordinary course we would expect the anode current A to increase, but the grid G is made more positive, and this extra potential on the grid G increases the number of electrons flowing to the anode B, the total number being still distributed between the two anodes. The current to B increases, and the extra electrons must come from those which would have gone to the A anode. The grid, therefore, acts as a means of diverting current from one anode to the other. By supplying an extra positive potential to the anode A, the tendency is to increase the current. At the same time we are increasing the number of electrons flowing to B, and therefore decreasing the number flowing to A, so that the result is that the number of electrons flowing to A decreases and therefore the A anode circuit has negative resistance; if we include in it a circuit having positive resistance such as an oscillatory circuit, continuous oscillations may be produced.

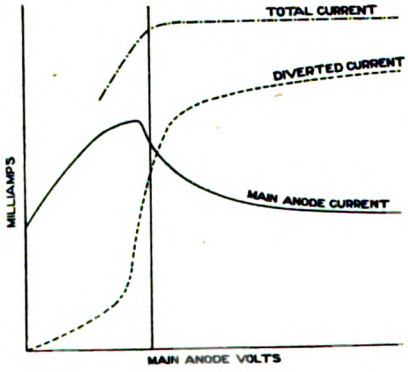


*Fig.* 12.

The theory which was worked out long before the actual valve was constructed, has proved to be correct by characteristic curves taken of the valve. Some actual characteristic curves are shown here (Fig. 12). We have the main anode current characteristic curve which is shown by the thick line. That represents the amount of current flowing to the left-hand anode, the anode marked A in the previous figure. The vertical line represents some steady voltage which is normally on the anode, say 60 volts. Now, if we increase that 60 volts to 70, we notice from that characteristic curve that the current in milliamps. decreases, and that decreasing effect is obtained from the top of the curve right down to the right-hand side, so that over that range of voltage the valve acts as a negative resistance. If the normal voltage i too small, the effect is longer obtained because the valve is no longer saturated. As we are increasing the voltage on the main anode marked on the bottom scale, we are making the grid more positive and increasing the current to B, and the dotted line shows the diverted current. If we compare the main anode current and diverted current we see where the electrons are going to.

As the B anode current increases, the A anode current decreases, and the total current is shown by the top curve. If we measure that value it will always remain the same. It is simply a question of two anodes dividing up the electrons between them. If one takes more, the other must take less. If we add the two together their currents will always be the same.

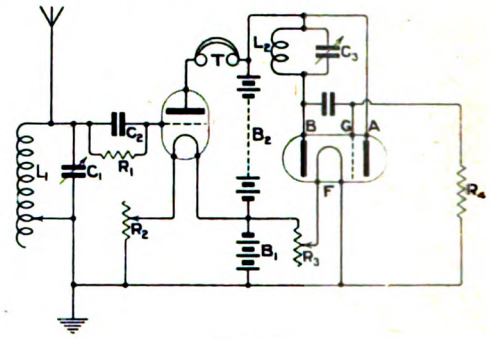


*Fig.* 13.

Fig. 13 shows a practical example of the way in which the Negatron is used as an oscillator for the reception of continuous waves. The right-hand portion, to the right of the battery $B_2$, is a simple receiving circuit using a leaky condenser, $C_2$ $R_1$, as the means of obtaining the rectification effect. That portion is simply the usual receiving circuit, but the left-hand portion is the negative resistance oscillator, which is the external heterodyne. It produces beats in the aerial circuit, and the oscillator is really the same as the previous illustration, except that we have got one or two practical details incorporated. For example, instead of having two batteries we have only got one $B_2$. Then instead of having a battery to prevent the grid being given a high positive potential we have a little condenser which is shown above the letter G, and this condenser is an insulating condenser, a resistance $R_4$ being provided to keep the grid from accumulating large quantities of electrons. It is not the ordinary grid condenser used for the purpose of rectification. We connect the oscillatory circuit $L_2$ $C_3$ in the B anode circuit, and the moment that it is connected up and the filament rheostat $R_3$ adjusted to a suitable value to produce saturation in the valve, the circuit $L_2$ $C_3$ will oscillate.

Fig. 14 shows another use of the Negatron in a self-heterodyne circuit. Instead of using it as a separate oscillator for external heterodyne reception, I am now using it as a self-heterodyne. We have the receiving circuit L $C_1$, which forms the aerial circuit also included in the main anode circuit, so that oscillations may be set up in it, and all we have to do is to connect the telephones T in the position shown, or we can preferably connect the telephones in the other anode circuit. It makes little difference in which circuit you connect the telephones. Oscillations are set up by adjusting the filament resistance $R_3$.

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An interesting effect may be obtained with a circuit of this kind and that is the damping of the aerial circuit may be reduced, not quite to produce self-oscillation but sufficiently to produce a decrease of damping. It was proposed a long time ago, long before the three-electrode valve came into prominence, to use negative resistance devices of different kinds in this country to reduce the damping of circuits and so get stronger signals, and any negative resistance device, of no matter what type,

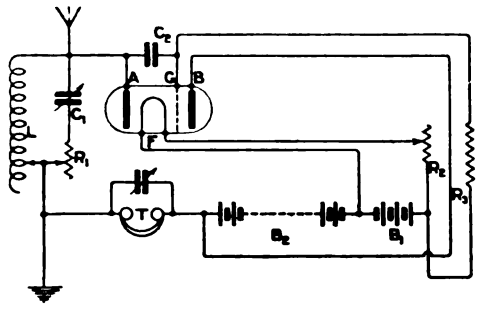


*Fig.* 14.

may be applied for this purpose. Where this is done, we can connect a resistance $R_1$ of about 30 ohms in $LC_1$, and, by adjusting the resistance of $R_1$, we can alter the damping of the aerial circuit just to the point preceding self-oscillation, and under those conditions we get very strong amplification of signals.

The last slide (Fig. 15) goes back again to a form of circuit in which two grid valves are used. In this case I have, instead of using a single grid to amplify low and high frequency signals, kept a separate grid for each particular process. One grid is reserved for high frequency amplification, and the other is kept for low frequency amplification. For example, in the first valve $V_1$, the incoming signals are applied to the top grid, the high frequency oscillations in the first valve passing through the primary of $L_2$, which passes on the high frequency oscillations to the top grid of the second valve. This also amplifies the high frequency oscillations which are passed on by means of the transformer $L_3$ to the three-electrode valve $V_3$. The rectified currents are communicated by the low frequency transformer $T_1$ back to the second grid of the first valve, the amplified low frequency currents being applied by the intermediary transformer $T_2$ to the lower grid of the second valve. They are again amplified and finally signals appear in the telephones T.

### Mr. C. F. Phillips.

With regard to Capt. Donisthorpe's remarks, I should be glad if he would explain, if it is convenient to do so, exactly how the circuit he showed on the screen as Fig. 7 is made to generate oscillations. I saw, I think, two ways in which it may possibly generate, but it struck me when I heard the telephones humming on the table that it was generating at audio frequency. I take it that if this is so there may be some difficulty in varying the note, and as the amplifier in the form in which it stands is intended, I believe, to receive continuous waves without a separate heterodyne, I am not quite sure whether generation at audio frequency, without any ability to vary that frequency, would be very successful in the reception of continuous waves. I think that is the only remark that I have to make except to say that I very much agree with Mr. Scott-Taggart that the valve which Capt. Donisthorpe has called the "quadrode," but which I believe Dr. Eccles called the "tetrode," is in no way better than several three-electrode valves. The only saving that I can see is a saving of filaments, and filaments are not very expensive things, and I daresay that the particular filament of the type of valve we are looking at, would take a current probably of the order of 0·5 to 1· ampere, or something of that sort, whereas if we use three three-electrode valves of the type which are known as low temperature emitters we might get three valves and run three filaments at perhaps a third of an ampere, and so save in battery power. I am

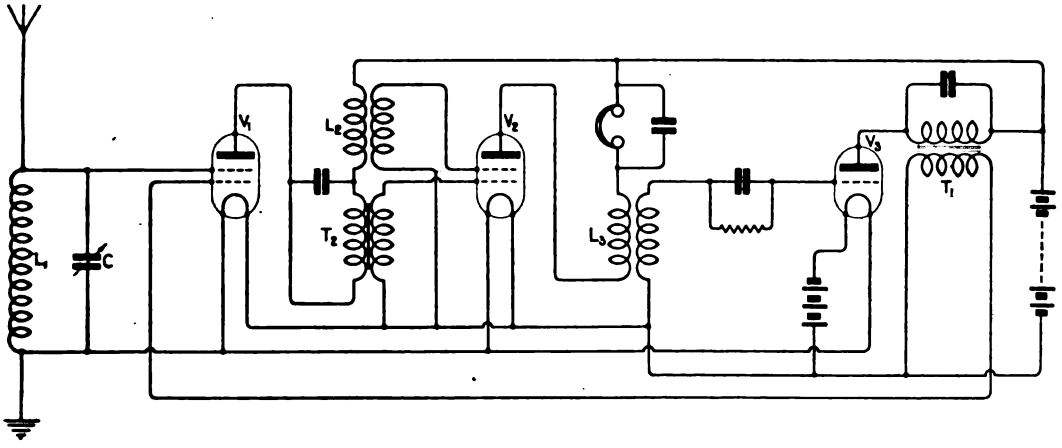


*Fig.* 15.

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not at all sure that three low temperature emitters in the future will cost very much more than one four-electrode valve. I say in the future.

**Mr. R. E. H. Carpenter.**

There are one or two questions which I should like to ask Mr. Scott-Taggart. First of all, I must express my appreciation of the extremely lucid way in which he explained the action of the "Negatron," device. In connection with that circuit I would like to know whether, when an oscillating circuit is connected in series with the "Negatron," the frequency of the oscillations bears a close agreement with the calculated $\sqrt{LC}$ value. It is difficult in the case of the ordinary triode arrangement to calculate your frequency, nor can it be given by any circuit arrangement, owing to the necessity of coupling the retroaction coil to the main inductance. I notice that the curves which he gives for the "Negatron" are curves in the ordinary sense in that they are not particularly flat at any point. I wonder whether such a circuit is particularly rich in harmonics.

I was interested in Mr. Scott-Taggart's remarks that it had been proposed long before the advent of the valve to use negative resistance devices to reduce the decrement of aerial circuits, and one would be interested to know what device other than the valve existed or whether that was merely the expression of a higher scope for the future.

**Mr. J. Scott-Taggart.**

With regard to the question of harmonics, I do not think any more harmonics are likely to be produced with a "Negatron" than with an ordinary valve system, because with that you have got a point of saturation, and, of course, the "Negatron" generates comparatively feeble oscillations, depending on the size of the valve and unless the negative resistance portion of the characteristic curve is employed the valve will not generate oscillations for the simple reason that the curve is not sloping down. With regard to the calculated frequency, that is nearly always the same as the actual frequency obtained, and the "Negatron" in that respect resembles a single circuit oscillator in which you have a single oscillation circuit without any reaction coil and connect the filament to the middle point on the inductance, and the two ends of the coil to the grid and anode of the three-electrode valve. Of course, the various effects which control the frequency bear on matter, for example, the anode filament current. With regard to the lessening of impedance, I did not say that a negative resistance device had been used to reduce aerial resistance to a critical value, but that it had been used generally, and applied to different kinds of circuits, especially with respect to telephone circuits. Dudell, for example, used one of his first arcs for the purpose of lessening the impedance of the telephone lines, and telephone apparatus, and he got a very marked increase in sensitiveness. The effect is really equivalent to the ordinary reaction effect obtained with the three-electrode valve. The two phenomena are identical in their results. He also proposed to use, instead of the ordinary arc, which is not suitable, a vapour lamp, and Cooper Hewitt a few years later in 1904 developed the idea considerably, and used the Cooper Hewitt lamp to reduce the damping in telephones, so that it was not a very great step to apply the principle to ordinary wireless signal circuits.

**Mr. Oswald J. Carpenter.**

I may have misunderstood Mr. Scott-Taggart, but I believe he stated that note frequency amplification is obtained, using the four-electrode valve he described. If this is correct, and the potential of the outer grid is varied at note frequency, it seems to me that any attempt to secure a condition for autodyne reception will result in generation of audio frequent oscillations. This is the case with the Marconi device which, however, employs a heterodyne unit for undamped wave reception, in accordance with the usual commercial practice.

In connection with this type of valve I should like to mention a possible field for experiment which may be of interest.

The single-valve telephony transmitter utilising "grid control" is becoming very popular with amateurs, particularly in view of the extended employment of short wavelengths. Unfortunately, you cannot obtain a very high percentage of modulation with the standard arrangement, since when the amplitude of the generated waves is varied very considerably the valve will momentarily cease to oscillate, and therefore the speech formation will become broken and very distorted. In Fig. 16

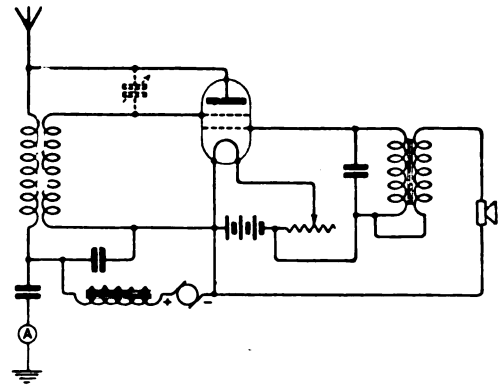

*Fig.* 16.

I give a circuit which is not new but which is not generally known. It will be seen that the microphonic control circuit is connected to the inner grid of a four-electrode valve. As this grid is nearer the filament than is the main grid, it is able to effect an equivalent control of the electron stream with smaller potentials. The utility of this is evident when handling outputs necessitating high grid potentials. The microphonic currents are, of course, no longer superposed on the oscillatory currents, which now traverse the outer grid circuit, and substantial modulation of the high-frequency energy may be secured with improved stability. The anode and outer grid circuits are sometimes coupled through a variable capacity, as indicated by dotted lines.

I should like to mention another matter, that is, the attempt to deprecate the need for four-electrode valves. One point which seems to have been overlooked is that if you have one valve doing the

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work of three, you have but one replacement charge in place of three. Also, you have a more robust filament, yet one taking considerably less current than three and having a considerably longer life—that is an interesting point regarding maintenance. As for construction, I do not think the difficulties are as great as has been suggested. Captain Donisthorpe has brought a specimen and from this it will be seen that, unlike the low-temperature emitters mentioned, the electrodes are not of a micrometrical nature, and that they are well spaced.

**Mr. M. Child.**

I should like to ask Capt. Donisthorpe whether he has received satisfactory telephony with one of these four-electrode valves. I think that must be a point of interest to a great number of us here, because we are interested in transmission and we are certainly interested in the reception of telephony, and I think if we could have a little information on how this valve behaves in actual practice in the reception of speech it would be probably useful.

A good deal has been said to-night on the question of negative resistance. I believe that it is of great utility in eliminating atmospheric disturbances. When we get strong X's, by the use of some such apparatus as Mr. Scott-Taggart has described in his "Negatron" circuit, and put into the aerial circuit a large artificial resistance in order to damp that circuit very considerably, so that it is very insensitive to the atmospheric currents which may be passing, we can yet wipe out from our signal currents the effect of that resistance completely. I believe that is, theoretically, at any rate, quite a useful proposition.

**The President.**

It appears to me that the four-electrode valve will prove very useful and find its level like the three-electrode valve. It is a case of the survival of the fittest. It is a pity we have no one here who can give us data as to the life of the valve and its robustness, but we do not seem to have anybody here who is experienced in using it for reception. I do not know whether the life of the valve is effected by having to perform several operations. There is no doubt that there is a great deal to be said for the low temperature valves. The small dimensions of the valve are not a thing to be despised.

I will ask Mr. Scott-Taggart to reply.

**Mr. J. Scott-Taggart.**

There is only the question of oscillating and low frequency. In order to get that low frequency oscillation you must have—(I think the reference is to the double grid valve)—you must have some form of tight coupling which in the particular circuit that I gave did not exist. There is no back coupling at all; I couple no anode circuit to another grid circuit. In the single valve circuit there is just a pair of telephones. There is no telephone transformer with a winding going back on to one grid, so that the arrangement could not produce low frequency oscillations. There is also a point raised on the life of the filament. I do not think that these valves last any longer than the ordinary valves. The filaments are of the same size, and if you assume the valve costs 45s., and three ordinary valves cost 45s., when one of these particular type burns out 45s. has gone, whereas in the case of the three-electrode you may have two left out of the three!

*(To be concluded.)*

# Potentiometer Control of H.F. Amplifiers

By S. O. Pearson, B.Sc., A.M.I.E.E.

SINCE the advent of Mr. Campbell Swinton's "plug-in" type of high-frequency transformer* for intervalve coupling, a great many amateurs have adopted tuned high-frequency amplifying circuits using these transformers. One of the chief difficulties to be met with in this type of circuit is the tendency for continuous oscillations to be set up and maintained, and some means must be provided for their control. Various methods are available, but it is intended here to discuss in particular the potentiometer method of control, and an attempt is made to explain why an amplifier controlled in this way is liable to be noisy, especially when receiving telephony. This fact has been noted and mentioned in *The Wireless World* of February 4th last, by Mr. H. H. Whitfield, who won the Second Prize in receiving the American Amateur Transatlantic Signals last December.

When both the grid and plate circuits of a three-electrode valve are tuned to approximately the same wavelength, self-oscillation usually occurs, regenerative action taking place through stray coupling between the two tuned circuits, and, in the case of speech reception, must be stopped. Greatest amplification and sharpest tuning are obtained when self-oscillation is just on the point of occurring. Speech cannot be received satisfactorily with the valves oscillating.

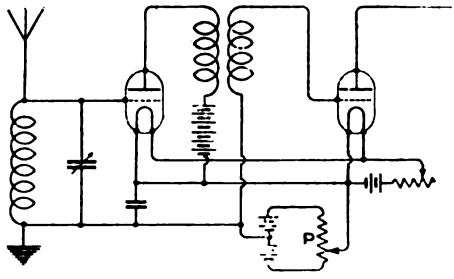


*Fig.* 1.

A very common method of preventing this oscillation is provided by the use of a potentiometer operating on the grid potential of either the first or all of the high-frequency valves. Fig. 1 represents such an arrangement, the first two valves and one high-frequency transformer being shown. P is the potentiometer for varying the normal grid voltage.

* See *The Wireless World*, June 25th, 1921.

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The self-oscillation may be stopped either by raising the normal grid potential above that of the filament so that a grid current flows, thus increasing the damping of the tuned grid circuit, or by lowering the grid potential until the valve operates on

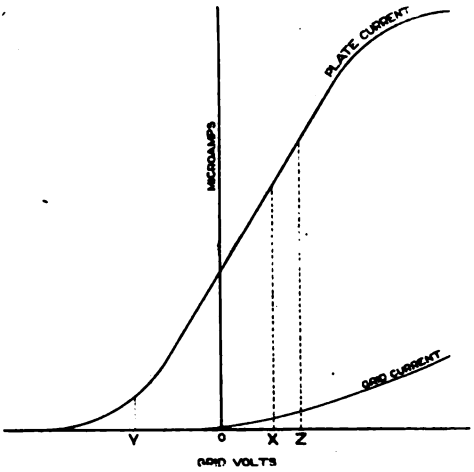


*Fig.* 2.

or near the lower bend in the characteristic curve, in which case oscillations will cease on account of the reduced steepness of the characteristic curve at the point of operation.

In Fig. 2 is shown a typical characteristic curve of a three-electrode valve. Suppose that X and Y are the upper and lower values respectively, at which oscillations just cease; at both of these points there is still a considerable amount of retro-active effect between the two tuned circuits of the first valve, and telephonic signals will be heard at their loudest. If now the grid potential is raised above X or lowered below Y it will be found that signals become very much weaker or even inaudible; that is, the regenerative effect varies with the grid potential, or, in other words, the damping of the circuit is dependent upon the value of the grid potential. It is this fact which accounts for the noisiness when receiving the *carrier wave* of a telephonic transmission, even though the carrier wave emitted by the transmitting station be pure.

Suppose that the normal grid potential of the first valve is set at some such value as Z (Fig. 2) and that a small continuous oscillation of constant amplitude, such as that due to a non-modulated carrier wave, is applied to the grid circuit; the plate current will then have a steady oscillating component in direct proportion. If now the normal or average potential of the grid is lowered slightly, but not sufficiently to allow self-oscillation to occur, the amplitude of the oscillatory component of the plate current will be increased, since the retro-active effect has been increased. In addition, the mean value of the plate current will be reduced, since the average value of the grid potential has been lowered. These effects are shown clearly by the curves of Fig. 3.

The curve A represents the impressed oscillation in the grid circuit; at P the normal value of the grid potential is suddenly lowered. The corresponding plate current is shown by curve B. It will be observed that at the point Q, corresponding to the point P of curve A, the mean value of the plate current is suddenly lowered, *but the amplitude of the oscillation has increased.* The dotted lines represent the mean values of the curves.

We see from the above that the oscillations in the plate circuit vary in amplitude as the grid potential is varied. Well, now suppose that the normal grid potential is varied at an *audio frequency*, whilst the carrier wave of a telephonic transmission is

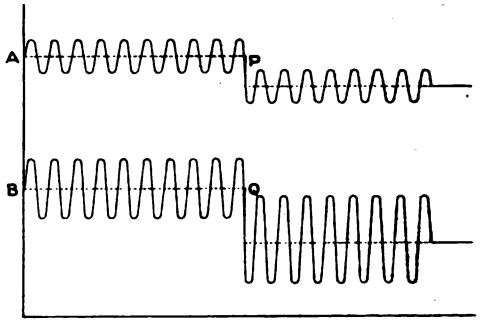


*Fig.* 3.

being received. The resulting oscillating component of the plate current will vary *in amplitude* at the audio frequency; in other words, the received carrier wave is being modulated locally and an audible note will be heard in the telephones. This effect is shown graphically by the curves of Fig. 4. As before, the curve A represents the received carrier wave; B is the low-frequency impressed voltage on the grid. The actual potential impressed on the grid is the resultant of curves A and B, and is given by the curve C. For the reasons given previously, the oscillating component of the plate current will be somewhat as shown by the curve D.

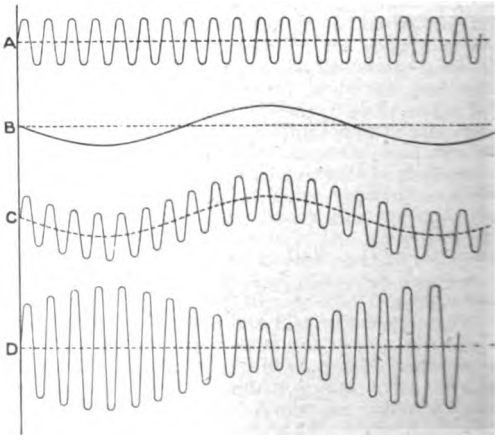


*Fig.* 4.

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Actually, of course, the mean value of the plate current will vary at the low frequency, but this is unimportant, and has been omitted for the sake of clearness; the tuned intervalve transformer offers a very low impedance to the audio frequency component, which is therefore not passed on to the next valve. But the modulated high-frequency component is amplified by the succeeding valves and is rectified at the detector, giving an audible note in the telephones. It must be borne in mind that the curves A of both Fig. 3 and Fig. 4 represent the induced voltage in the aerial or grid circuits, and not the actual voltage variation of the grid itself. When working on the straight portion of the characteristic the grid voltage curve will be an exact reproduction of the plate current curve to a different scale. When the damping is zero the oscillating grid voltage will be exactly equal to the induced oscillations, but if there is any damping at all the grid voltage becomes less.

If the carrier wave ceases whilst the audio-frequency oscillation is being applied to the grid of the first valve, no sound is heard in the telephones, since low-frequency oscillations are not passed on by the transformers.

In practice there are many low-frequency disturbances, such as those due to electric light mains, electric railways, etc., and under the above conditions such disturbances will modulate the received carrier wave of a telephone station, resulting in a great deal of noise in the telephone receivers; atmospherics also seem to be aggravated by this type of circuit.

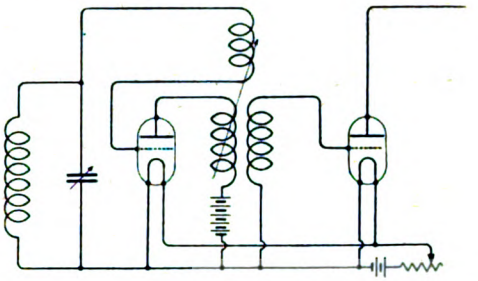

*Fig. 5.*

It will be found that the amplifier will work much more silently if the oscillations are controlled by means of "negative reaction," that is, by magnetic coupling between the input and output circuits so directed as to neutralise the stray coupling between the circuits. When employing two or three stages of high-frequency amplification the author has found that by coupling the grid circuit of the first valve to the first high-frequency transformer, the self-oscillation of the whole amplifier is brought under control. The coupling coil is connected in series with the grid lead of the first valve and mounted above the first H.F. transformer in such a manner that the coupling can be varied by sliding the coil or otherwise. Fig. 5 shows a diagram of connections for such an arrangement. One coupling coil will work satisfactorily over a very wide band of wavelengths.

# Notes

### A Foretaste of the Broadcasting Service.

Those who in this country are fortunate enough to possess receiving stations had a foretaste on Thursday evening, May 11th, of what, with the new broadcasting schemes, may be a matter of every-day occurrence. By arrangement between the *Daily Mail* and the Marconi Company the progress of the Great Fight between Carpentier and Lewis at the Albert Hall was broadcasted by wireless telephony from Marconi House. The result was listened to all over the country, and by many wireless enthusiasts in France as well. As one amateur, who spoke on his wireless telephone set shortly after the conclusion of the fight, expressed it, the only regret was that the fight was over so quickly that the transmission that he had enjoyed was all too brief.

The time is soon coming when news items of this kind will be distributed regularly, and will be taken advantage of by all who avail themselves of the Postmaster-General's new concession for the installation of receiving sets.

### 2MT: Changes in the Transmission from Writtle.

We are advised that, commencing on Tuesday, May 30th, the transmission by Writtle will commence at 8 p.m. instead of 7 p.m., on a wavelength of 400 metres instead of 700.

In view of this change in wavelength and the fact that all broadcasting will be conducted on wavelengths of this order, it will be necessary to get busy in the design and construction of suitable receiving sets. This is a subject well worthy of careful experiment, as many new problems are met with in designing receivers for short-wave reception.

### Irish Wireless Station Destroyed by Fire.

The Admiralty Wireless Station at Bunbeg, Donegal, was attacked by Irish Republicans on Wednesday, May 10th, and after the entire furniture and other effects had been publicly sold, including the private property of the evicted personnel, the station was set on fire and burnt to the ground. The damage is estimated at more than £20,000.

### The Institution of Electrical Engineers.

The Annual General Meeting of the Institution of Electrical Engineers (Corporate Members and Associates only) will be held on Thursday, May 25th, 1922, at 6 p.m., at the Institution Building, Savoy Place, Victoria Embankment, W.C.2, to receive and consider the Accounts for the year ended December 31st, 1921, and the Annual Report of the Council, and to elect Auditors.

Copies of the Accounts and Report (which will in due course be published in the Journal) can be obtained from the Secretary.

The Annual Conversazione will be held on Thursday, June 29th, 1922, 8.30 to 11 p.m., at the Natural History Museum, South Kensington, S.W.

Invitation cards will be issued in due course.

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**Hourly Weather Messages: Additions.**

The following changes took place with effect from May 1st, 1922:—

(i) An additional Hourly Route Weather Message, giving observations for 0400 G.M.T., is transmitted by Air Ministry, call sign GFA, wavelength 1,680 metres, at 0435 G.M.T. daily.

(ii) An additional Hourly Route Weather Message, giving observation for 0400 G.M.T., is also transmitted by Le Bourget, call sign *ZM*, wavelength 1,680 metres, at 0428 G.M.T. daily.

**Personal.**

Among those called to the Bar at the Middle Temple last week appears the name of Mr. John J. Honan, A.M.I.E.E. Mr. Honan served as a Wireless Officer in the R.F.C. and R.A.F. and was for some time an Assistant Instructor in the Wireless Telegraphy Direction-finding School at Farnborough.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With regard to the letter of Messrs. T. W. Higgs and A. C. H. Bassano in the issue of May 13th, I am glad to be able to furnish a reply to their query. The station whose telephony they heard was the Signals Experimental Establishment, Woolwich Common, Woolwich, London. I heard the telephony myself, but this is scarcely surprising, as I am but a couple of hundred yards away. The establishment is under Government control and does not make a regular habit of these *impromptu* concerts, and, moreover, *XYZ* is not the proper call for this station.

E. H. RAWED.

Royal Arsenal, Woolwich.
*May* 12th, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I want to thank you for publishing on page 146 my letter of April 16th. It brought a reply from **2CV**.

Referring to the details you give about my station on the same page, I would like to point out that my wavelength is now 360 metres instead of 525 and that I listen on all waves between 180 and 400 metres..

May I remark that by his letter appearing on page 178, Mr. G. W. G. Benzie seems to have wrongly interpreted my message of April 17th. That message read: "CQ, British Amateurs de 8AB — Pse tell 2CV last night QRK," by which I meant to ask all British Amateurs to inform **2CV** that the night before I had received him well,

I hope you will publish the above and with anticipated thanks I renew all good wishes to your magazine.

LÉON DELOY,
French "8AB."

*Tuesday, May 9th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Referring further to your issue of April 22nd, I was very interested in Mr. J. Bever's low power transmission.

To-day I was working **2 KQ** Wolverhampton, using rectified A.C., 600 volts, 16 milliamps., 9·6 watts. Aerial radiation, 0·3 amps. He reported my speech excellent and asked me to reduce power. I gradually brought this down, **2 KQ** reporting still perfect speech. The final power used was as follows: H.T., 70 volts, plate circuit 4 milliamps., aerial reading not readable, power input 0·28 watts. **2 KQ** reported speech weak but still readable.

I think this is a record. The distance between Sheffield and Wolverhampton being 84 miles.

During the whole of the test **2 GJ** Sheffield was listening-in and will confirm this statement.

I should like to hear if any of your readers have transmitted speech this distance on such small power.

W. A. WARD,
Working **2 IQ.**

Sheffield.
*April 30th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was very interested in the correspondence pointing out some of the nonsensical matter published in our daily and weekly press.

The following extracts from *The News of the World* of December 4th last are no doubt interesting. The amazing bits of information occur in a serial called "The Death Message," by Lawrence Clark:

> He took up the telephone head-piece, clamped it over his ears and put out his sallow hand to a pointer on the left side of the table. "I am waiting for the Poldhu call," he exclaimed, "it is due about now. We get our English news from them." Suddenly bright blue crackle and viciously vital sparks leapt into being in the spark gap. The groping swing of the pointer in his left hand stopped; his right shot out and gripped a slip of paper headed "News Message." "This is Poldhu speaking now," he exclaimed. The sparks continued to crackle, and his right hand slipped over the foolscap, taking down the news sent out broadcast from the Cornish station, two thousand miles away. A little later on the operator gave the pointer a swing to the right, and suddenly a higher pitched note began to sound in the little cabin and the spark gap grew into blue flashing life. "This is the 'Imperator' speaking," he exclaimed.
>
> Miss Morris, in the dead of night, apparently slipped into the wireless room, and for five minutes she occupied herself, and then cautiously stepped out, but evidently her evil work was thoroughly done.
>
> The operator, however, being trained from early youth, soon discovered she had tampered with the machine, and for two days no message was received or sent on board the steamer.
>
> The operator was utterly baffled by the machine's mysterious failure, for try as he would it was impossible for him to send a message. What in God's name had she done? He had examined everything—the leading-in wire, the magneto, the detonator. What had she done? With infinite care he went over every section of

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his instrument, and apparently nothing was out of order, yet it was impossible for him to send or receive a message.

A little later, however, his eyes were resting full on his magneto, and as he looked a sudden thrill went through him. He recalled something he had said to Miss Morris five days before, something about the details of the magneto. In a flash his fingers were busy with the screws. In fifty seconds the magneto was in his hands. He held it, scrutinised it, turned it, and screwed it into place again. Then his fingers flew to the sending key, but almost before he touched it he knew that the instrument was in order.

Miss Morris, acting on his own gossiping information, had merely reversed the poles of the magneto. A brilliant trick most difficult to discover. And he, like a fool, had been two days finding it out.

I think the last remark about his being a fool is the only true thing mentioned in the whole paragraph.

RENÉ H. KLEIN.

# Book Review

HANDBUCH DER DRAHTLOSEN TELEGRAPHIE UND TELEPHONIE. Eugen Nesper. 2 Vols. 10″ × 7″, xlviii + 708 + 545 pp. 1,321 Figs. Price 390 marks + 25 per cent. (*Julius Springer*, Berlin, 1921.)

The publication of this work will be welcomed by every radio engineer and student of the subject who can read German. It is, in our opinion, one of the best books of its class yet written on the subject. Generally speaking, it is descriptive and non-mathematical, although the results of mathematical investigations are given and full references to original papers where further details can be found. The subject is covered very thoroughly; the book is well printed, very well illustrated and bound and produced in the style which one associates with the name of Springer. The last hundred pages are devoted to compilations of radio literature, both articles and patent specifications classified under subjects and alphabetically under authors' names. Although English titles have sometimes proved too much for the German compositor, this part of the book will prove very valuable for purposes of reference.

A surprising feature of the book is the war atmosphere that seems to pervade the author's review of the subject. The opening sentence of the book may be translated as follows: "Radiotelegraphy obtained its baptism of fire in the Russo-Japanese War in 1904, and proved itself already then to be reliable in military service, not only at Port Arthur but especially for the *Times* News Service between Wei-hai-wei and Chemulpo. It was also used for espionage purposes. . ."

We must say, however, that although, as one would expect, the apparatus described and illustrated is preponderantly German, the author has evidently endeavoured to be scrupulously fair in describing the development of the art and in apportioning credit for invention and discovery. We were struck by the entire absence of that pronounced national bias which usually pervades German books dealing with this aspect of the subject.

Some errors are bound to creep into a work of this magnitude, especially when an author attempts to discuss the wireless projects of other countries. One is surprised, for instance, to see Corfu in a list of British Colonies and stated to have a radio station forming part of the British system in the Mediterranean. In the same paragraph we have "St. Jones" (Newfoundland). We also notice that the velocity of electromagnetic waves is stated to be $1{\cdot}96.\ 10^{10}$, instead of $2{\cdot}96.10^{10}$, and several other errors of a minor nature. These detract little from the value of the book, which should certainly be found in every library of serious radiotelegraphic literature.

G. W. O. H.

# Calendar of Current Events

**Sunday, May 21st.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by PCGG, The Hague, Holland.

**Tuesday, May 23rd.**

Transmission of Telephony at 7 to 7.25 p.m. on 700 metres, followed by C.W. calibration signals on 1,000 metres by **2MT**, Writtle, near Chelmsford.

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton. "The Electronic Theory," by Mr. Blakemore.

**Wednesday, May 24th.**

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (Tea, 5.30 p.m.).—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C., "Some Effects of Capacity on Mutual Induction with Special Reference to their Application to the Elimination of Jamming," by Mr. J. H. Reeves.

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Lecture by Dr. Richardson.

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION.

"Thermionic Valves," by Mr. Barratt.

**Friday, May 26th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"The Amateur Set," by Mr. T. Brown Thompson.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—Informal Meeting.

WOOLWICH RADIO SOCIETY.

8 *p.m.*—At the Woolwich Polytechnic: An Exhibition of Home-made Amateur Wireless Apparatus.

**Saturday, May 27th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

Field Day.

**Thursday, June 1st.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.

Open Night and Soirée.

**Friday, June 2nd.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—Lecture by Mr. F. L. Hogg.

BRADFORD WIRELESS SOCIETY.

Lecture by Mr. H. F. Yardley.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear*—[ED.]

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 90th meeting of the Club was held on Wednesday, May 3rd, at Shaftesbury Hall, Bowes Park. The chair was taken by Mr. G. Evans and, after the usual formal business, he announced that the lecture for the evening was entitled "A Few Notes on Wireless Direction Finding at Sea," by Mr. G. E. Dockree.

Mr. Dockree apologised at the commencement, saying that he had had very short notice and had consequently been unable to prepare his notes as thoroughly as he would have wished. He then outlined the principles involved in direction finding, explaining that there were two methods in use. First, that known as the unilateral method, and secondly, the bi-lateral. The essential part of the apparatus was a frame aerial, which was capable of being turned through 360 degrees. This was known as the compass coil. This, used in conjunction with a suitable receiver, enabled the bearings of the transmitting station to be ascertained, but gave two readings, 180 degrees apart. The unilateral method consisted in coupling the compass coil to the aerial so that the current in the aerial had the effect of either decreasing the current induced in the compass coil or increasing it, thus showing on which side of the receiving station the transmitting station lay.

The lecturer explained how, by using two shore stations in communication with each other, the position of the transmitting station could be found. He went on to explain the possible sources of error, which might arise from several causes and give rise to inaccurate results. Chief among these causes were unskilled operating, bad design of instruments, leaky insulation and errors due to configuration of the land. The question of insulation was very important, as a leak which was of small account in ordinary message work was sufficient to affect seriously the results in direction finding.

After questions had been asked by several members, and answered by Mr. Dockree, the meeting closed with a vote of thanks to him for a very interesting lecture.

## Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the club-room at 7.45 p.m. on May 5th, with Mr. A. Bever in the Chair. After the business of the meeting, the Chairman called upon Mr. T. Brown Thompson to give his lecture on "The Automatic Recording of Wireless Signals and the Turner Trigger Relay." The lecturer, in a very able manner, reviewed the various methods of recording, and then passed on to the Turner relay, which he described. By the courtesy of Mr. A. M. Bage, of the Leeds Society, who loaned the apparatus, Mr. Thompson was able to demonstrate to some extent the working of the relay and tape machine, in conjunction with one of Messrs. Burnham's single-valve sets. Unfortunately, owing to slight damage to the recorder in transit, the demonstration was not as successful as it might have been, but nevertheless it was very much enjoyed, and at the conclusion a very hearty vote of thanks was accorded the lecturer.

A competition for members has been arranged as per particulars below, and it is hoped that all who possibly can will give it their support :—

*Rules for Competition.*

(1) Prizes (*a*) Valve value, 15s.;
(*b*) Vernier Condenser, value 7s. 6d.:
(*c*) Free Membership of Society for One Year.

(2) The above prizes will be awarded for the most efficient Single Valve Receiving Set for wavelengths of 600 metres and below.

(3) All Inductance Coils, Switches, Filament Resistances, Condensers (variable and fixed), Grid Leaks, etc., to be made entirely by the competitor. Condenser plates for variable condensers may, however, be purchased.

(4) Ebonite Knobs, Inductance Formers (if any) and other turned articles may be purchased, if desired.

(5) The general finish, design, compactness, will be taken into account.

(6) The competitor may choose the "Unit" method, viz., detector panel, tuner, condenser, or the complete set in one case.

(7) The Judges will be Mr. J. Bever, Mr. A. Barber and an independent judge appointed by the members, but who should preferably be a good telegraphist.

(8) Arrangements for tests to be made by the judges and announced later.

(9) Competitors' names to be handed in to the Organising Secretary.

(10) Closing date for entries, May 19th.

(11) Judging to take place at the club-room on Thursday, July 13th.

(12) Complete instruments, marked with competitors' name, to be handed in not later than 7.30 p.m. on July 12th. Any competitor not complying with the above conditions will be at once disqualified.

(*Signed*) N. WHITELEY,
W. G. A. DANIELS.
*On behalf of the Committee.*

## The Wireless and Experimental Association.*

At the meeting held by the Association at the

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Central Hall, Peckham, on April 26th, much interesting matter was brought forward for discussion. The difference between hard and soft vacuum valves was fully explained, together with the main points experienced in the use of each type. Several theories were put forward for explaining the reception of spark signals on the ordinary telephone system, one being that the high-frequency currents were by-passed to the microphone and there rectified. Much interest followed a description of an application of the dual amplification circuit, whereby an ordinary low-frequency amplifier could easily be converted by merely putting a plug connected to the new instrument in the place of the valve. Further discussion was raised on the action of the choke control or constant current system of modulation for telephony transmission. One member having hurried down from the meeting of the Wireless Society of London was able to illustrate several four-electrode valve circuits, but the large number of inductances used was more than many would care to manipulate.

On May 3rd, after the usual business had been conducted, a discussion was raised regarding the relative efficiencies of cylinder coils against basket coils of similar tuning ranges. The conclusion arrived at was that basket coils were the better on short waves, owing to lower self-capacity, although due to the lesser extent of the magnetic field, closer coupling was necessary. A paper was then read by one of the members on the determination and plotting of characteristic curves of two and three-electrode valves. This brought a very interesting evening to a close.

Full particulars for membership may be obtained from the Assistant Secretary (Mr. W. J. Joughin), 21, Troughton Road, Charlton, S.E.7.

### Radio Scientific Society, Manchester.*

The last meeting of the above Society for the winter session 1921-2, took the form of a Social Evening and Smoking Concert, held on Wednesday, April 26th, at 16, Todd Street, Manchester, under the able direction of the Society's Chairman, Mr. G. G. Boullen.

A most enjoyable time was spent, due in no small part to the efforts of the members and their friends.

It is proposed to hold a series of outdoor excursions during the summer, details of which will be available shortly.

The Secretary, Mr. H. D. Whitehouse, will be pleased to answer all enquiries addressed to him at 16, Todd Street, Manchester.

### Southport Wireless Society.*

Hon. Secretary, Mr. W. E. Otter, 5, Tower Buildings, Leicester Street, Southport.

A General Meeting was held on Tuesday, May 2nd, a large muster being present at the Queen's Hotel, Promenade, the Chair being taken at 8 p.m. by Mr. A. F. Stock. The Chairman called upon Mr. A. B. Brown to deliver a paper on the subject of "Accumulators."

The lecturer very clearly described the reason why every care should be taken of accumulators, and how, when a little care is practised, the life of a cell is prolonged. With the aid of internal parts of a cell he showed the results of neglect, such as short circuiting the terminals with files, or any conductor of electricity, overcharging, failing to keep covered with electrolyte and also permitting cells to discharge under 1150, the test being taken with a hydrometer.

It was a splendid lecture, being thoroughly enjoyed by all present. Mr. Brown volunteered to give another lecture in the near future and clear up any points he may have missed.

A hearty vote of thanks was accorded Mr. Brown at the close of the meeting.

### The Willesden Wireless Society.*

Applications to Mr. F. A. Tuck, 87, Mayo Road, N.W.10.

The Society are still going ahead; new members are turning up at every meeting, and we are holding a special elementary class under Mr. A. Arnoll on Friday evenings at 8 p.m., at headquarters, 25, Station Road, Willesden Junction. The lecture on May 2nd was given by Mr. Wyatt, who dealt with the theory and practical working of a single valve receiver, particularly emphasising the correct adjustment of filament and plate potential, a thing usually overlooked by most members. A very interesting and instructive meeting was the result, and the lecturer was accorded a hearty vote of thanks.

### South London Wireless and Scientific Club.*

Although silent as regards reports of our work in South London in connection with the extension of wireless telephony and telegraphy, and also our research of various matters appertaining thereto, we have by no means been silent in action.

Our meetings since our last report in January have been so enormously successful that South London seems to talk of nothing else, and of course we are busy catering for the "boom" which is the outcome of the co-operation of the members of the Club and of which we feel naturally proud.

It would be practically an impossibility to record in full the details of lectures, discussions, demonstrations, etc., which take place twice a week regularly, but nothing seems to have been so overwhelmingly successful as the lecture and open discussion which was given by our Secretary (Mr. Allen), and words could not adequately express the manner in which this was received. He began with a very lucid description of simple tuning, and later turned to the more advanced stages, yet constantly keeping to analogies to explain to those of our younger members the intricacies—how to stop howling whilst a set is oscillating, to the higher stages of tuned high frequency amplification. The questions evolved were so numerous that the discussion will be extended to another evening to enable all the members to express their views.

This is only one of our many interesting items, and only one of the many ways in which we assist the amateur in South London. Our Secretary (Mr. Allen), 9, Newington Causeway, will be pleased to give full particulars to anyone interested in a live society devoted to matters appertaining to wireless in all its branches.

### Dartford and District Wireless Society.*

Hon. Secretary and Treasurer, Mr. E. C. Deavin, 84, Hawley Road, Dartford.

At the usual meeting of the Society, held at

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Dartford Grammar School on Friday, April 21st, 1922, a most interesting and instructive evening was spent. Owing to a priority engagement our Vice-President (Mr. J. R. Smith, A.M.I.E.E.) was unable to be present.

The Hon. Secretary read the minutes of the last meeting, which were approved by those present. The Society's valve receiving set was used and tested for the first time and gave satisfactory results.

The question of a transmitting licence was fully discussed, and it was agreed a portable transmitting set would be very beneficial for experimental work.

Mr. Prangnell, Assistant Secretary, brought along another valve for trial, and a very instructive evening terminated at 10.30 p.m.

### Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The April monthly meeting of the above Society, held at the Woolwich Polytechnic on Friday, April 28th, at 8 p.m., took the novel form of a concert entirely by wireless. From 8 o'clock to 9.45 p.m. the ether was filled with music and speech, and by means of a 7-valve receiving set and loud speaker (kindly loaned by the S.E.E.) this was rendered loudly and clearly audible to the audience. Promptly at 8 o'clock, directly after our Chairman (Mr. McPherson, B.Sc.) had opened the meeting, the voice of Captain Hughes, of the S.E.E., came ringing through the loud speaker, announcing the first item, which was a gramophone item. From that time till 9.10 p.m. we were regaled by fine music, including solos by Miss W. Beeson and Captain Hughes, violin solos by Mr. D. Young, interspersed with gramophone pieces. All were loudly and distinctly rendered.

Directly the S.E.E. had finished we heard the well-known voice of **2FQ** calling us from Blackheath. For twenty minutes we had more delightful music: we envied **2FQ** his selection of beautiful gramophone records. The moment he had finished we heard **2ON** from Walthamstow call us up, and for another quarter of an hour we listened to more delightful music.

Unfortunately we had to close down at 9.45, owing to Polytechnic rules, and so had to forego hearing **2OM**, who also promised to come on.

### The West London Wireless and Experimental Association.*

Club-rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

Meeting held Thursday evening, April 27th, a fairly good attendance made. The larger part of the evening set aside for the purpose of receiving the special transmission by Mr. Read, Member I.R.E. (2MO) to the League of Arts, at Victoria, on the occasion of a lecture by Mr. Gibbon, of the Engineer's Chief Office, G.P.O., where a large audience listened to a demonstration of general broadcasting composed of music, speech and weather reports, etc.

Mr. Read, of Messrs. Burnham's, will in the near future—probably during June—give a demonstration and lecture on their Ultra IIII set.

### Streatham Radio Society.

Messrs. A. G. Wood and J. S. Newton were responsible for calling an inaugural meeting of the wireless enthusiasts of Streatham, which was held on Wednesday evening, May 3rd, at "Compton," Pendennis Road, Streatham, S.W.

Among the company present were Messrs. H. J. Swift, J. S. Newton, S. C. Anstee, A. G. King, S. W. Johnson, K. M. Quilter, J. Stone, C. F. Leleu, A. G. Wood, G. P. B. Hassel and S. C. Newton.

The usual formalities were gone through, and Mr. A. G. King was elected Hon. Treasurer. Mr. S. C. Newton promised to act as Secretary *pro tem.*

It was unanimously agreed that the Society should immediately start to function under the above title, and the nucleus of a Committee was elected, consisting of Messrs. J. Stone, A. G. Wood and S. W. Johnson.

It was proposed, seconded and carried that the Society should, as soon as possible, endeavour to become affiliated with the Wireless Society of London, and that a public room should be secured for holding the meetings, the members present offering to assist in finding suitable accommodation.

The first Committee meeting will be held on May 17th, when the details in connection with the formation of the Society will be dealt with.

Applications for membership and any wireless matters interesting to members, should be forwarded to Mr. S. C. Newton, A.M.I.E.E., Hon. Secretary, "Compton," Pendennis Road, Streatham, S.W.

### Southampton and District Wireless Society.*

A meeting of the above Society was held on Wednesday, May 3rd. Although the attendance was not so large as usual, owing to the weather, a fair number "Braved the Storm." A good evening's buzzer practice was given for the benefit of new members. Several new members were made. Mr. Bateman's lecture was held over till the following week, when it is hoped a large attendance will be present. As the membership is increasing so rapidly, all those interested in wireless in Southampton and district would be well advised to make early application for membership, as there are likely to be some drastic alterations in rules, *re* entrance fee, etc. For full particulars apply to the Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

### Wireless Society for Ilkley and District.

It has been proposed that a Wireless Society be formed for Ilkley and District. Will all those who are interested communicate with Mr. E. S. Dobson at "Lorne House," Richmond Place, Ilkley, in order that a preliminary meeting may be arranged.

### Slough, Windsor and District.

Will those interested in the formation of a Wireless Society for Slough, Windsor and District, please communicate with Mr. Thomas W. Price, Caversham House, Dolphin Road, Slough.

### Fife and District.

Mr. Arthur C. Peterson, is anxious to form a Wireless Society in his district, and will be glad to hear from any others interested at Walkers Buildings, Dunbeath, Methil, Fife.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"BEGINNER" (Walthamstow)** *asks (1) For the wiring for a panel. (2) What wire to put on his coils. (3) For capacity of primary condenser.*

(1) *See* diagram (Fig. 1). (2) The two coils mentioned may be wound with No. 26, the 5" coil being used as tuner primary and the 4" loading coil. Tuner secondary may be a reaction coil, 6" × 4" of No. 30. (3) 0·001 mfd.

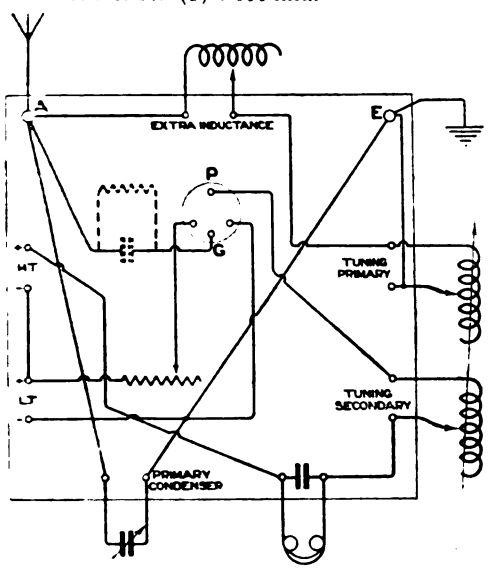


*Fig. 1.*

**"G.A.B." (Harlesden)** *asks if No. 16 gauge copper wire is suitable for a twin aerial. (2) For dimensions of a loose coupler to tune from 400 to 4,000 metres.*

(1) Yes. (2) Primary 10" × 7" of No. 24, secondary 8" × 5" of No. 26.

**"A.C.McA." (King's Heath)** *asks (1) How to add an H.F. valve to a single valve circuit shown. (2) If this is the best way to add another valve. (3) Any alterations to make his single valve set more efficient.*

(1) *See* Fig. 3, page 812, March 18th issue. The series-parallel switch may be omitted if desired. It is, of course, an improvement. (2) Yes for a large range of wavelengths (3) Add a reaction coil, as shown in the circuit referred to.

**"E.B.U." (Birmingham)** *refers to Fig. 8, page 778, March 4th issue, and asks (1) If 2,000 ohm telephones could be used. (2) If condenser across telephones is necessary, and, if so, what value. (3) If 60 volts H.T. is O.K. (4) If a 0·00005 mfd condenser could be used.*

(1) Yes. (2) Yes. 0·001 mfds fixed. (3) Yes. (4) This might be used for a grid leak for short wavelengths.

**"W.K." (Johnstone)** *refers to Fig. 12, page 726, February 18th issue, and asks (1) If no reaction coil is required. (2) How to tune the aerial circuit. (3) If "Ora" valves would work on this set.*

(1) No. Capacity reaction is employed by means of the condenser C.1. The A.T.I. should have a slider as in your diagram. (3) Yes.

**"D.V.D." (Edinburgh).**—You should use a frame aerial about 4' in diameter with 20 turns. You will require three or four valves for **PCGG.** The circuit may be as Fig. 4, page 32, April 1st issue, with the substitution of your frame for the A.T.I., the earth and aerial connections, of course, not being needed. An additional H.F. valve may be added exactly as the first valve shown.

**"A.S.B." (Rotherhithe)** *asks (1) For criticism of a two-valve set. (2) If the set would receive Dutch concert loud enough for a loud speaker. (3) Windings for H.F. transformer to cover 300 to 1,500 metres. (4) For suitable valves.*

(1) Circuit is O.K. 0·01 mfd. is too high for a telephone condenser; make it 0·001 mfd. (2) Signals should be fairly strong, but will be hardly good enough for a loud speaker. (3) To cover the range properly three transformers should be used. However, you might try formers 1½" diameter, 3" long, wound with No. 40 for a commencement, winding other transformers to complete the range when you have found what the one suggested gives. (4) R.4b, V.24, R, or similar type of valve.

**"BEGINNER" (Herne Hill)** *asks (1) If correct that we do not recommend crystal sets on account of the small number of spark stations working. (2) If it is possible to commence with a loose coupled crystal set and later to use the coupler with a valve set.*

(1) Crystal sets are still useful, especially for a beginner, as they give an insight into the principles of wireless in a simple and inexpensive way. They will give spark stations of which there are still numbers of ships, as well as stations such as **FL,** and telephony at short distances. So many people



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are dissatisfied with the results, which are, of course, not so good as those given by the valve that we find it necessary to warn them of the limitations of a crystal. (2) Certainly in many different ways.

**"H.F." (Blackpool)** *asks* (1) *Cost of receiving licence.* (2) *If the reaction coil may be omitted from the circuit shown in Fig. 8, March 4th issue, Q. & A. columns.* (3) *For criticism of an aerial.*

(1) 10s. a year. (2) This will greatly decrease the efficiency of the set. The wavelength range will depend on the size coil and condenser used. A range up to 4,000 metres can easily be obtained with single layer coils. (3) The aerial will not be efficient if one part bends back on the other as shown in the diagram. It would be better to use only one 20′ length.

**"HARD VACUUM" (Renfrewshire)** *asks* (1) *Is it worth while buying an old 1″ spark coil for the wire on it to be used for winding telephones and transformer.* (2) *What is counted as "lead in" in measuring the length of an aerial.* (3) *If a three winding transformer may be used with H.R. telephones and a Brown 100 ohm loud speaker are used together.* (4) *If there is any advantage in spacing aerials more than 100′ apart.*

(1) Possibly, if you can buy the coil cheaply, but you would have some trouble in using the wire again as it is probably bedded in wax. (2) We do not know the official ruling, but think it probably measured from the horizontal part to the part where the lead enters the house. (3) Yes, but the three winding transformer is not necessary. Connect the H.R. telephones in series or in parallel with the H.R. winding of an ordinary telephone transformer, using the L.R. winding for a loud speaker. (4) No.

**"NEMO" (Teneriffe)** *wishes to add an H.F. valve to his set and asks* (1) *If best to connect secondary inductance to negative of the battery or through a potentiometer.* (2) *If connections across both windings of the H.F. transformer would increase efficiency.* (3) *If reaction coil connected in rectifier anode would give better results than if in anode circuit of first valve.* (4) *If possible to relay telephony without distortion by means of a moving coil relay.*

(1) Potentiometer would somewhat improve results. (2) A condenser across one winding only would be sufficient. (3) Yes. (4) The ordinary moving coil relay is quite unsuitable. The Johnsen-Rahbek loud speaker, described in May 6th issue, is suitable for your purpose.

**"E.J.L." (Liverpool).**—(1) and (4) Maximum wavelength of the aerial circuit would be 2,600 metres, and to tune the secondary to this value a capacity of 0·0008 mfd. would be required. This is rather high for a crystal set and it would be better to rewind the secondary with No. 30 for use with a 0·0005 mfd. condenser. (2) If the earth lead is of good thick wire we would recommend its use rather than shortening it and the aerial as well. (3) Very little difference, but for a crystal set we advise the use of H.R. telephones.

**"A.A.B." (Barnesbury)** *asks* (1) *For a suitable single-valve set for 300 to 30,000 metres with slab coils.* (2) *Values of component parts for such a set.*

(1) A suitable circuit is shown in Fig. 2, page 811, March 18th issue, together with suitable values for the parts. The chief reason we do not recommend slab coil sets for short wave work is that suitable proportioning of A.T.I. and reaction coils is not very easily carried out for short waves with the coils.

**"NEW READER" (Regent's Park)** *asks* (1) *For criticism of a single-valve set.* (2) *What stations he should receive.* (3) *Wavelength range of set.* (4) *For improvements to the circuit.*

(1) Very fair, but see 4. (1) Paris, Poldhu and Nauen, also ship and coast stations on 600 metres; also Croydon telephony on 900 metres. (3) 400 to 4,000 metres. (4) Add a reaction coil between the positive H.T. and the anode of the valve, coupling this with the A.T.I. The coil may be 6″ by 4″ of No. 28. Put a 0·001 mfd. condenser across the H.R. winding of the telephone transformer.

**"F.V.K." (Willingham)** *refers to Fig. 3, page 555, November 26th issue, and asks* (1) *If the telephone transformer may be left out if 2,000 ohm telephones are used.* (2) *Suitable windings for L.F. intervalve transformers.* (3) *Why only 6 volt H.T. is shown.* (4) *If grid condenser and leak are advisable.*

(1) Yes. (2) Primary half an ounce and secondary 1½ ounces of No. 44 wire wound on a soft iron core ½″ diameter and 2½″ long. (3) This is only a diagrammatical representation of the position of the H.T. and not intended to represent the actual value. (4) This will probably improve rectification.

**"L.E.K." (East Kilbride)** *proposes to use a single-valve set on a small indoor aerial or frame and asks* (1) *For criticism of circuit.* (2) *Wave range of a certain coil.* (3) *Particulars of frame.* (4) *For what alterations to set to use 120 ohm telephones.*

(1) The circuit is correct but it will be useless on either of the aerials you suggest. Use either an outside aerial or three or four valves indoors. (2) With a small outside aerial the actual wave-range will be 4,500 metres. (3) With a frame aerial at least three valves should be used, and the frame may then have about 40 turns, about 4′ in diameter. (4) The only alteration necessary is the inclusion of a telephone transformer as in many sets recently given.

**"V.C.G." (Richmond).**—(1) Your circuit would probably work slightly better than the one referred to. A good circuit is shown in Fig. 4, page 61, April 8th issue. (2) This circuit will not receive C.W., but will be suitable for spark and telephony, although the results will not be so good as those given by the circuit referred to in question 1. (3) A valve and crystal set should give better results than a single-valve set if a good crystal is used.

**"L.R.F." (London, E.C.)** *asks for a telephony circuit using one H.F. valve with a crystal rectifier.*

A suitable circuit is shown in Fig. 4, page 61, April 8th issue. The grid condenser and leak shown in it should be omitted. A carborundum crystal would be quite suitable.

**"NEBULA" (Southampton)** *asks* (1) *For information about* FL *time signals at 9.25 a.m.* (2) *If, in erecting an aerial, any advantage would be obtained in spacing the strands of cable through a 1″ diameter ring.*

(1) See page 572, December 10th, 1921 issue. (2) The capacity of the aerial would be very slightly

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decreased, but no observable improvement in reception would be obtained.

**"S.E.P." (Fulham)** *asks why his single-valve set, with tuned reaction, and crystal detector, will not oscillate below 300 metres, and what alterations to make to go down to 100 metres.*

You do not tell us the size of your coils which probably limit the oscillation point. At the lowest wavelength it would probably be necessary to couple the coils very tightly together as each coil would be very small. You might try the addition of a very small condenser across the grid and plate.

**"R.H.M." (Shepherd's Bush)** *asks* (1) *If an enclosed three-valve circuit is correct.* (2) *If suitable for one H.F. detector and L.F. magnification.* (3) *Whether a "Q" valve should be used as rectifier and "V.24's" as magnifiers.* (4) *Where to connect reaction coil.*

(1) Arrange one filament resistance to control the two magnifying valves and the other the rectifier. Connect the 0·001 mfd. condenser across the anode winding the L.F. transformer. (2) Yes. (3) Use a "Q" or preferably "QX," or "R.4 b" as rectifier, with "V.24" magnifiers. (4) Connect reaction coil in rectifier anode circuit.

**"VARMER GILES" (Exeter)** *asks* (1) *If a single crystal set is O.K.* (2) *How the polished surface can be removed from ebonite.* (3) *Why a compass needle turns to the magnetic north.* (4) *Wavelength of a circuit.*

(1) Yes, but preferably add a small block condenser across the telephones. (2) By rubbing with very fine emery paper. (3) Consult an elementary text-book on electricity or apply to the Editor of *Conquest*. (4) On a standard P.M.G. aerial, circuit would tune to 2,800 metres.

**"R.W." (Nottingham)** *asks* (1) *Why cracklings and whistlings are heard when the aerial is cut out.* (2) *Why no signals besides Paris and Moscow are received.* (3) *Windings for a small ship tuner.*

(1) and (2) In the absence of any information it is impossible to answer these questions. The first may be due to defective batteries, bad connections and many other causes. The second is very likely due to the use of too large coils which will not tune down to ship wavelengths. (3) The loose coupled tuner with a 0·0003 mfd. secondary condenser, windings may be—primary 4" × 6" No. 24, and secondary 3" × 6" of the same wire.

**"S.P." (Barrow-in-Furness)** *asks* (1) *For circuit diagram to add a crystal rectifier to a single-valve circuit.* (2) *If any use could be made of a potentiometer.* (3) *If a local concert should be received.*

(1) and (2) A suitable circuit is shown on page 61, April 8th issue. The grid condenser and leak should be omitted from the circuit. The potentiometer shown should be used in conjunction with the crystal. (3) This will depend entirely on your tuner windings for the wavelength of telephony. As you tell us neither your windings nor the wavelengths of the telephony, we cannot assist you.

**"H.E.W." (Islington)** *asks* (1) *For a good five valve telephony receiving circuit.* (2) *Why any circuit used on his aerial "howls," and if this is due to a near-by power station.*

(1) A good circuit for this purpose is shown in Fig. 3, page 31, April 1st issue. (2) This may possibly, but not very probably, be due to interference from the power station. It is more likely to be due to a circuit fault, such as the presence of two L.F. transformers near to each other, or to grid and plate leads being run too close together. As you give us no information about your set, we cannot assist you much.

**"A.L.S." (Louvain)** *asks* (1) *Meaning of the abbreviations "A.T.I." and "A.T.C."* (2) *For diameter of certain gauges of wire in Continental form.* (3) *If honeycomb or basket coils may be wound with No. 39 wire, if several wires in parallel are used.* (4) *For criticism of proposed circuit.*

(1) "Aerial Tuning Inductance" and "Aerial Tuning Condenser. (2)

| | | | | |
|---|---|---|---|---|
| No. 20 S.W.G. | corresponds | with | ·91 | millimetres. |
| No. 22 | ,, | ,, | ·71 | ,, |
| No. 26 | ,, | ,, | ·46 | ,, |
| No. 28 | ,, | ,, | ·38 | ,, |
| No. 30 | ,, | ,, | ·32 | ,, |
| No. 36 | ,, | ,, | ·19 | ,, |
| No. 40 | ,, | ,, | ·12 | ,, |
| No. 44 | ,, | ,, | ·08 | ,, |

(3) Yes, but it would be somewhat difficult to do as you will have to twist up five or seven of the wires in sufficient quantity for the coil before starting to wind it. (4) A two-valve circuit should be quite satisfactory. The anode resistance of 70,000 ohms is suitable for French valve. For winding information, see Figs. 4 and 5, pages 38 and 39, April 8th issue, in which coil numbers refer to number of turns. Wind on a 5 cm. former, 2 cm. wide.

**"E.H.S." (Princetown)** *refers to Fig. 3, page 640, January 7th issue, and asks* (1) *Capacity of the blocking condenser, and if it is necessary to use this condenser if his telephone transformer has a condenser built into it.* (2) *Voltage of the H.T. battery.* (3) *If this set is as efficient as certain other combinations of valves.* (4) *If "R" valves should be used throughout.*

(1) About 0·002 mfd. (2) About 80 volts if "R" valves are used. (3) The special merits of this set are that it gives uniformly good H.F. amplification on all wavelengths above about 800 metres. It is, however, unsuitable for short wavelengths. The combination one H.F., one rectifier and one L.F. is better on short waves, but is not capable of working over large ranges of wavelengths with any one H.F. transformer. (4) Yes.

**"J.A.C.B." (Dinting)** *asks* (1) *The approximate range of an A.T.I. with 11" × 5½" of No. 28.* (2) *The capacity of a condenser consisting of two tubes of glass 6" × ⅜" and 6" × ½", sliding one inside the other.* (3) *If 2,000 ohm telephones can be used with a valve.* (4) *If FL can be received on an indoor aerial.*

(1) This will tune a P.M.G. aerial to about 4,500 metres. (2) 0·00002 mfd. This is too small to be useful with the above coil. (3) Yes. (4) Possibly with one valve. Almost certainly with two.

**"G.A.G." (Colchester).**—The suggested method should be quite correct. The basket coils may be about 1½" internal diameter wound with about 100 turns of the Litz wire equivalent to No. 21. The arrangement you suggest will be about the best you can do at the price.

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**"BEGINNER" (Reading)** *asks* (1) *For criticism of a circuit.* (2) *For data of inter-valve transformer to use certain materials.* (3) *If a frame aerial can be used with an indoor aerial on his circuit.* (4) *If he should get* **PCGG** *with a 20′ indoor aerial and frame coils.*

(1 and 3) Do not use an indoor aerial as well as a frame. Your circuit will be satisfactory if your frames are replaced by tuning coils and also if your crystal arrangements are modified to be as Fig. 5, page 92, April 15th. (2) Use one ounce of the No. 40 for a primary, and two ounces for a secondary. (4) With a careful adjustment this circuit should give **PCGG.** Only four questions, please.

**"INTERESTED" (Cumberland)** *asks* (1) *If an aerial with a right-angle bend in the middle has the same natural wavelength and is as efficient as a straight wire aerial.* (2) *If a long lead-in inside the house is detrimental to the strength of signals.* (3) *Referring to Fig.* 10, *page* 726, *February* 18*th issue, asks what would be the approximate cost of the set less telephones and aerial.* (4) *If it would give Continental Spark and C.W. stations, and if a similar set is on the market.*

(1) Approximately the same natural wavelength, but probably about two-thirds the efficiency. (2) A long lead-in is undesirable as it is almost sure to run near bad conductors and bad dielectrics which will lead to loss and inefficiency. (3) Omitting the anode variable condenser, which is not required, a set of this type could be made for about £4, including batteries. (4) Yes. Most single valve sets on the market approximate very closely to this type.

**"W.B." (Bradford).**—The probable reason for your weak signals is the use of an indoor aerial with a single valve. Either put up a good outdoor aerial or add two more valves. With these alterations, both telephony and Paris time signals should be heard. **PCGG** will then be audible, but the provision of extra coils will not help you to get this station without the more important alterations we have suggested above.

**"C.S.S." (ss. "Collegian").**—(1) The grid leak may be about 3 meghoms. (2) These inductances may be wound with about No. 40 wire, and may have considerable self-capacity without serious inefficiency. They need not be accurately tuned to the wavelength. (3) Capacity reaction may be used for both spark and C.W. (4) With this set about 60 volts should be sufficient.

**"SPARKS" (Capetown)** *asks* (1) *What instruments are necessary to add six valves to a crystal set with a separate rheostat to each valve.* (2) *The approximate cost and diagram.* (3) *The voltage for the batteries for "V. 24" valves, and if separate batteries to each valve are necessary.* (4) *Which is better,* 100′ *single wire aerial or* 70′ *twin.*

(1 and 2) There are literally scores of ways in which six valves can be combined, but we strongly recommend you not to use more than two or three until you have sufficient experience to decide what type you prefer. Your crystal circuit is of very poor type, and it would be much better to improve this rather than to add a number of valves in a circuit which you will not understand and will therefore find unmanageable. Separate resistances for each valve are quite unnecessary. The cost of a six-valve set would be £20 to £30. (3) Six volts and 30 volts. Separate batteries are not necessary for each valve. (4) There is little to choose between these.

**"BELL RINGER" (Walsall)** *asks* (1) *Correct H.T. for an "R" valve.* (2) *Criticism of a circuit.* (3) *If it will receive telephony.* (4) *If an aerial with four wires* 20′ *long, placed* 2′ *apart would be suitable.*

(1) About 60 volts. (2) Rearrange the circuit as in Fig. 2, page 140, April 29th issue. (3) Yes. (4) Aerial is very poor for a single valve set. A greater length should be used if at all possible.

**"A.T.N." (Thornton Heath).**—The circuit you refer to is a very poor type and we would advise you to modify it on the lines of Fig. 3, page 812, March 18th issue. Also, for a set of this type at least 80 volts is desirable with "R" type valves.

**"H.R." (Jersey)** *asks how to connect up certain gear and if capacity reaction can be employed.*

The Fleming valve which you possess is a rectifier only. We should, however, recommend you to purchase a three-electrode valve, which will enable you to receive C.W. as well as giving much stronger signals. If you retain the Fleming valve, connections should be as in diagram (Fig. 2). Reaction cannot be used with these valves.

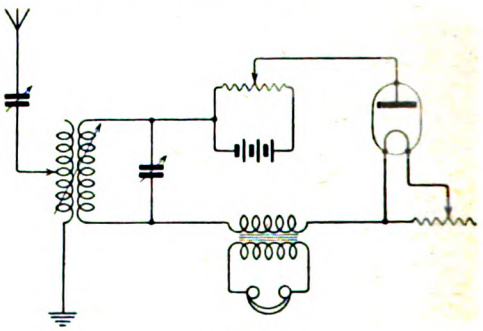

*Fig.* 2.

**"PUZZLED DUTCHMAN" (Hinckley).**—As you do not give the size of your aerial we cannot give the windings exactly, but for a maximum of 1,100 metres the A.T.I. may have about 150 turns on a former 4″ diameter, with a slider for tuning, and the reaction coil 100 turns on a diameter of 3″. These coils would then give you 700 metres as well.

**"A.J.S." (Darwen)** *asks the capacity of a condenser of* 2 *mils mica,* $\frac{5}{8}$″ *wide and* 2″ *long.* (2) *If the H.T. arrangement of* **"F.L." (Grimsby),** *on page* 642 *can be used for a French or Mullard valve.* (3) *If not, how to make it do.*

(1) 0·0005 mfd. for each active sheet of mica. (2 and 3) For French valves the arrangement will be suitable, but for Mullard valves which require less anode voltage, use four 50 volt lamps in series and tap off one nearest to negative of supply.

**"ELECTRON" (Broomsgrove)** *refers to pocket set, March 4th issue, and asks* (1) *How much No.* 36 *wire to obtain for A.T.I.* (2) *If tappings should be taken at equal lengths or equal number*

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*of turns.* (3) *Weight of wire for the reaction coil No. 26.* (4) *If an "Ora" valve will be suitable.*

(1) About 2 ounces. (2) Tappings at equal numbers of turns. (3) About 2 ounces. (4) The article in question states that best results were obtained with a French "H" soft valve. It will not be so good with an "Ora" or other make of hard valve, though perhaps much more stable and easier to manipulate.

**"J.B.W." (Greenock)** *asks* (1) *How many turns of No. 44 will be required on a 2" diameter by ½" former for 2,600 and 1,050 metres H.F. transformers.* (2) *Advice regarding reception of* PCGG. (3) *If sufficient protection from lightning is obtained by shorting aerial and earth terminals.*

(1) The term "2" by ½"" is very vague. It has been found that a 1½" diameter former with two windings each 4" No. 40 D.W.S. is a good transformer for 1,050 metres, from which you will see that your former appears to be too small for an efficient transformer. (2) On a single or two-valve set this station will be rather difficult to tune in at your distance. The best method is to carefully tune up set beforehand by using a buzzing wavemeter set tuned to 1,050 metres. (3) On a small aerial installation this is quite sufficient.

**"FAWLEY" (Hants)** *asks if certain windings are correct for a loose coupler; also for reaction coil for same.*

The inductance of primary is 17,500 mhys., and secondary 12,600 mhys. Primary will tune standard aerial to about 3,500 metres. This wavelength will require a 0·0003 mfd. condenser across secondary. A suitable reaction coil might be 3" diameter, wound with 7" of No. 30.

**"THERMIO" (Coventry)** *asks* (1) *For a 3 valve diagram with switching arrangements.* (2) *Connections for changing from a plain aerial to a coupled circuit reaction tuner.* (3) *For a modification of a circuit previously given in these columns without stating in which issue it was published in.* (4) *For formula for calculating capacity of variable and blocking condensers.*

(1) The diagram given on page 3, April 1st issue, appears to meet with all your requirements with the exception of separate filament resistances, which you can add yourself. (2) The circuit should be connected to a four-pole two-way switch as shown in the diagram (Fig. 3). It will be seen that the one variable condenser may be used for both circuits, because for the long wave tuner—plain aerial—the condenser will require to be in parallel with the A.T.I. (4) Variable and blocking condenser capacities may be calculated by the use of formula given under **"GRATEFUL," (Lytham),** page 60, April 8th issue.

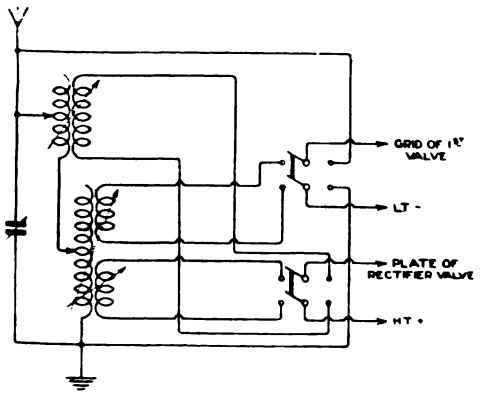


*Fig. 3.*

**"R.F.F." (Sidcup)** *asks how many yards of wire are required to make a coil to receive on* 1,050 *metres.*

A 3" diameter former, 7" long, wound full of No. 24 wire—about 3 ounces—will tune a standard P.M.G. aerial to about this wavelength, but a reaction coil, tuning condenser and two or three valve amplifiers will be required to receive the Dutch concert at all strongly.

**"T.E." (Walthamstow)** *has trouble from "crackling noises."*

These noises are probably caused by induction from the telegraph and telephone wires which appear to surround you. The two-valve L.F. magnifier will make matters worse because the currents in the wires are at low frequencies. Connect a 0·001 mfd. condenser and telephones across the terminals of your single valve panel and listen to signals to see if noises are reduced by cutting out the L.F. magnifier. At the same time test each valve on this panel as it may possibly be due to a defective valve.

**"WIRELESS" (Wood Green)** *asks* (1) *If necessary to space turns when winding coils with enamelled wire.* (2) *If three sliders would be more useful than two.* (3) *If essential to have telephone transformer for 8,000 ohm telephones in a valve set.* (4) *Size of coils recommended for single-valve set.*

(1) No. (2) No. (3) H.R. telephones may be used in valve sets, but there is the danger of breakdown of insulation due to anode voltage. A 1·1 ratio transformer might be used, but the efficiency of the set would be decreased. (4) For a wave-range of 3,000 metres the A.T.I. should be 6" diameter, wound with 10" of No. 24, and the reaction coil 5" diameter, 8" long wound full of No. 28 wire.

**"W. McN." (Dublin)** *asks* (1) *If legal to make a magnetic detector.* (2) *The inductance of a 3" by 8" tube wound with No. 23 enamelled wire.* (3) *Receiving range of set, consisting of above inductance, a 0·0005 mfd. condenser and a magnetic detector.*

(1) For small aerials they are not worth making. (2) About 2,200 mhys. (3) Your diagram is incorrect; the A.T.I. condenser, and magnetic detector should all be in series to earth. You might possibly hear ships, but that is about all. The maximum wavelength will be 1,200 metres. You should be able to buy a piece of carborundum very cheaply, and could mount it in a clip made of clock spring. It will be more satisfactory than a magnetic detector.

**"F.S." (Wealdstone)** *asks* (1) *Size of wire for a 12" by 2½" former to tune to Paris and Madrid.* (2) *Size of a sample of wire.* (3) *If suitable for rewinding telephones.* (4) *If telephone condenser is correctly connected in his diagram.*

(1) For these stations a 6" diameter former wound with 10" of No. 24 enamelled wire will be required. For this purpose about 1 lb. of wire is necessary. As you have no tuning condenser you should provide a sliding contact in place of tappings. (2) It is

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regretted that the specimen must have gone astray. (3) Wind the bobbins full of No. 44 wire, for which about half an ounce will be required. (4) Condenser is correctly placed. The range of set cannot be definitely stated. It depends considerably on the skill of the operator.

**"A.M." (Smethwick)** *asks for a diagram showing various combinations of three valves in a receiver circuit.*

A suitable diagram is given in the issue of April 8th, page 62. Additional switches for the filaments may be inserted if desired.

**"ANMAIR" (Liverpool)** *asks questions regarding a recording set.*

The current charge working the relay will be quite small, probably about 100 microamps. A suitable indicating instrument to use will be a Weston student's galvanometer, which has a centre zero and gives a full scale deflection with about 750 microamps. This instrument should be connected in series with the relay coils. There is no reason why the set should not record ships provided the circuit can be properly tuned to their wavelengths, and that the amplifier is suitable.

**"J.E.A." (Derby)** *refers to "Receiving Circuits" article, February 18th issue, and asks* (1) *For suitable winding for Fig. 5.* (2) *Winding for Fig. 10* (3) *Details of coils M & S, Fig. 7.*

(1) This is not a good circuit for you to use. (2) For a maximum range of 3,000 metres make the aerial coil 6" diameter by 10" long and wind it full of No. 24 wire. The secondary condenser should be 0·0005 mfd. and its winding 8" of No. 24 on a 5" diameter former. For this wave-range the aerial condenser should be connected in series with A.T.I. and not parallel as shown. This circuit will be suitable for telephony. (3) The coils given in previous reply will be quite suitable.

**"R.G.N." (St. Annes-on-Sea)** *asks* (1) *If "Ora" valves may be used for L.F. amplification.* (2) *If choke coils may be used in H.F. amplification in place of transformer and for diagram of two-valve circuit.* (3) *If advantage is gained by use of separate H.T. to each valve.* (4) *Times of* **FL** *telephony and number of valves required.*

(1) Yes. (2) It is possible to use suitably designed choke coils, but they are not efficient for short wave sets. The circuit should be arranged as shown in Fig. 3, page 812, March 18th issue, with the choke coil in place of the resistance in the plate circuit of the first valve. (3) No. There is no advantage in a circuit of the above type. (4) No definite programme is yet arranged. It should be heard with two valves.

**"S.S." (Staffs)** *has constructed an "Amateur Mechanic" crystal set and also a "Work" single valve panel on neither of which are any results obtained.*

If the instructions regarding these sets have been correctly followed out, they should both give satisfactory results. Are you sure that your aerial is not earthed directly instead of through the apparatus? Make certain of this and also try another pair of telephones.

**"G.B.W." (Frimley Green)** *asks if it is possible to increase the range of Mk. III tuner by substituting slab or basket coils in place of existing windings; also what other alterations to make.*

This should make quite a useful alteration. Make the A.T.I. of basket coils of No. 24 and the secondary of No. 30 wire. Arrange for the A.T.C. to switch either in parallel or series with the A.T.I

**"H.G.G." (London, N.1)** *asks* (1) *For criticism of two-valve diagram.* (2) *Would above set receive Dutch concert.* (3) *Number of plates of certain size for a 0·002 mfd. condenser.* (4) *Whether to connect a Vernier condenser in series or in parallel with A.T.C.*

(1) The connections of this set are wrong. A correct diagram is shown in Fig. 3, page 12, March 18th issue. (2) Not as at present arranged, but when correctly connected and carefully adjusted it should do so. (3) With 1/16" between fixed plates, 36 fixed and 35 moving plates, will be required for 0·002 mfd. Owing to the small spacing and the number of plates required, the building up of this condenser will be found difficult. (4) This should be connected in parallel with the A.T.C.

**"AERO" (Liverpool)** *asks* (1) *If circuit shown for adding additional H.F. valve to existing valve set is correct.* (2) *If* **PCGG** *would be received on above with additional two valves for L.F. magnification.* (3) *Gauge of wire to use for earth lead.* (4) *The best point from which to take down lead from aerial.*

(1) This is incorrect. There is no H.T. to the first valve. Connect up as Fig. 3, page 812, March 18th issue. (2) Yes. (3) This should be of fairly stout wire—No 18 or 20 copper or of lighting flex. (4) The down-lead should be taken from a point which allows it to drop at right angles to the horizontal part of the aerial, which is usually at the end nearest to the house.

**"S.E.H.R." (Birmingham)** *sends crystal circuit diagram and asks* (1) *What additional apparatus is required for a single-valve set.* (2) *For diagram showing arrangement.*

(1) On page 90, April 15th issue, are two single-valve circuits, either of which will give good results. The following apparatus will be required: one valve; one 6-volt 30 amp. hour accumulator; one 30 to 50 volt H.T. battery; one 3 ohm filament resistance; one 0·0003 mfd. grid condenser; one 2 megohm grid leak; also additional coils.

**"BEGINNER" (Sowerby Bridge)** *asks* (1) *For diagram of set using three valves and a crystal* (2) *If the same will receive Dutch Concert.* (3) *Working range.*

(1) The most useful arrangement of three valves with crystal detector is shown in reply reply given to **"W.A.R." (Heywood)** in the issue of May 13th. (2) Yes, if the H.F. transformer between first and second valves is suitable for 1,000 metres. (3) This should receive most European stations within the wavelength range.

## SHARE MARKET REPORT

Prices as we go to press on May 13th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 14 | 6 |
| ,, Preference .. .. | 2 | 12 | 0 |
| ,, Inter. Marine .. .. | 1 | 10 | 0 |
| ,, Canadian .. .. | | 12 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | 1 | 2 | 0 |
| Preference .. .. .. .. | | 15 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 9. MAY 27TH, 1922 WEEKLY

## Simultaneous H.F. and L.F. Amplification

### SOME FURTHER OBSERVATIONS

By P. G. A. H. VOIGT.

(*Member of the Wireless and Experimental Association.*)

IN a previous article on this subject, published in *The Wireless World*, of December 10th, 1921, I described several circuits by which valves could be used for "dual" amplification.

In this article I wish to give improvements which eliminate most of the troubles experienced when working those circuits, and to give constructional details.

The first improvement is to decrease the number of adjustments by substituting for the tuned H.F. transformers special aperiodic H.F. couplings, which, though less efficient, are much more convenient to use.

This coupling is of the choke capacity choke type and functions in the same way as the resistance capacity resistance coupling. It has, however, the advantages that with this coupling it is not necessary to use extra H.T. as in the resistance coupling, and also a strong signal cannot paralyse the circuit. The difference is that both anode resistance and grid leak are replaced by air core H.F. chokes of comparatively low ohmic resistance, so as not to diminish the L.F. transformer efficiency. To increase the H.F. efficiency the two chokes are closely coupled. This electro-magnetic coupling alone would be sufficient to transfer the H.F. voltages from the plate to the next grid or crystal in the case of the longer waves, but for short waves the coupling condenser is required. This condenser need not exceed ·00005 $\mu$F. and when so small, will not decrease the L.F. transformer efficiency. The chokes themselves are slab or basket coils with an inside diameter of about 4 cms. and an outside diameter of about 9 cms. About 800 to 1,000 turns of 42 S. S. C. wire are sufficient for wavelengths up to about 4,000 ms. If there are too many turns, the circuit tends to whistle or howl.

The inner end of one choke should go to the plate and coupling condenser and the inner end of the other choke should go to the grid and to the other side of the coupling condenser. The outer ends should go to the L.F. transformer and by-pass condensers.

The efficiency of this coupling decreases when the wavelength decreases, just as in the case of resistance coupling, but if care is taken to avoid capacity between plate, grid and earth, it will still amplify down on wavelengths as low as 200 ms.

The valve socket should not be of the type which is moulded in ebonite, and the coupling should not be mounted on a valve plug, or the capacity will be too great for good efficiency on the short waves.

I have found on testing that the low capacity of a particular "Mullard Ora" valve made it more efficient than R valves on short waves.

A plug on which the coupling can be mounted is shown in Fig. 1. This plug has a much lower self capacity, and is much easier to make than a valve plug. A piece of ebonite is fixed on the socket to prevent short circuits between H.T. and Filament.

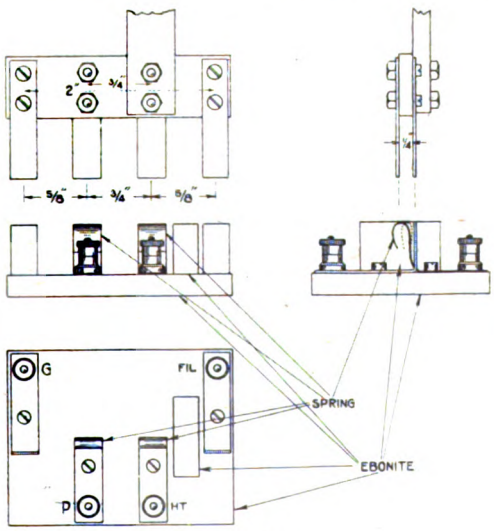


*Fig.* 1.

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The next improvement overcomes the following disadvantages :—

(*a*) Any leakage to earth has to pass through the crystal to get back to the valves.

(*b*) Any A.C. picked up by the circuit can not easily get to earth.

(*c*) The L.T. and H.T. have to be carefully insulated from earth.

All these defects are avoided by connecting the first grid, not to the aerial, but to a secondary coil coupled to the aerial coil. The crystal blocking condenser is then disconnected from earth and connected to the free end of the secondary. The —*ve* filament may then be earthed.

If this secondary is loosely coupled it must be tuned, but if it is tightly coupled it is tuned by virtue of its close coupling, and should not have a variable condenser.

A step up can be obtained by winding 50 to 75 per cent. more turns on the secondary than on the primary. This will considerably increase the signal strength. If the step up is too high, it will be very difficult to prevent oscillation when the plate circuits are tuned.

If the directions of the windings of primary and secondary are in opposition, the reaction condenser can be connected between the first plate and the primary.

To diminish radiation when receiving C.W. the aerial may be connected to a tuned coil which is loosely coupled to the tuned H.F. transformer instead of being connected direct to it as in Figs. 2, 3 and 4.

Fig. 2 shows a 1-valve dual amplification circuit. The signal is received on the aerial and tuned in the usual way. The secondary reverses and steps up the H.F. voltages to the first grid. In the valve the H.F. is amplified and again reversed. A small portion passes back to the aerial through the reaction condenser, and the remainder is passed by the aperiodic H.F. coupling to the crystal. The H.F. is rectified by the crystal and applied to the blocking condenser. Signals would be audible if telephones were connected across this blocking

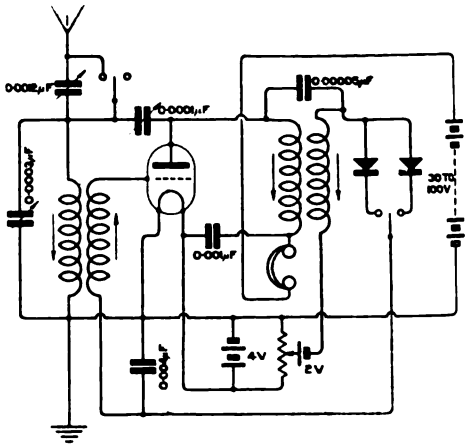


*Fig.* 2.

condenser. This condenser is, however, between grid and filament, and therefore the valve produces amplified currents in the telephones in the plate circuit.

Fig. 3 shows a two-valve circuit which is the same as Fig. 2, but with the addition of one valve connected by the aperiodic coupling for the H.F. and by an iron core transformer for the L.F.

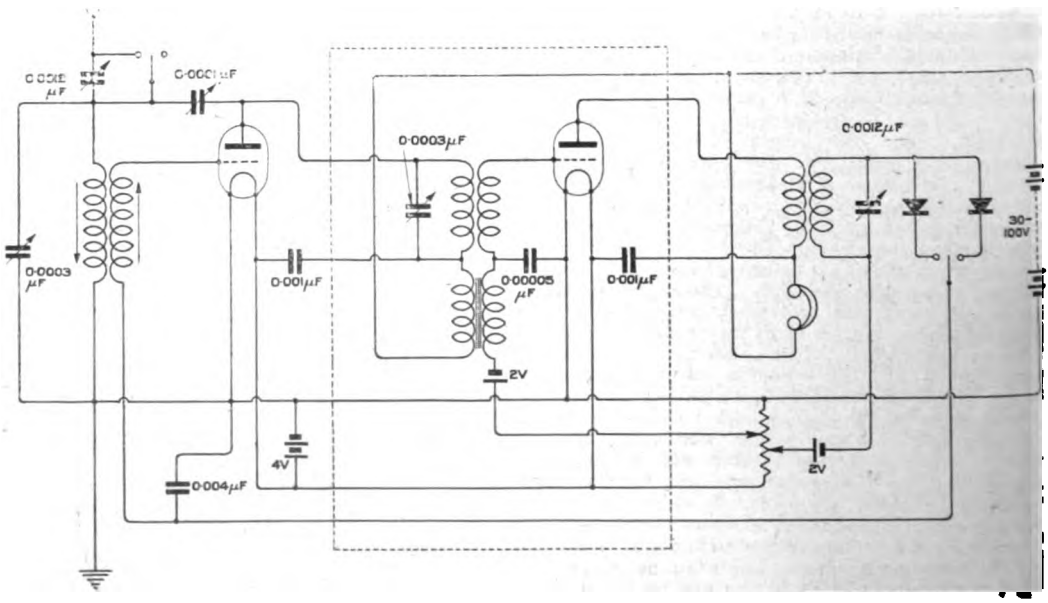


*Fig.* 3.

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In Fig. 4 a two-valve circuit is shown which uses tuned H.F. transformers for the intervalve coupling. This circuit is more efficient but more difficult to control.

It is sometimes advantageous when using a tuned H.F. transformer between valve and crystal to connect it so that the voltage is stepped down to the crystal because the crystal resistance is usually lower than the resistance of the valve.

The transformers which I shall describe can be used if the connections to the socket are changed. The tuning condenser is preferably left on the low resistance winding. In Fig. 4 the tuning condenser is shown on this winding, to which the crystal is also connected.

If these circuits buzz instead of oscillating, the trouble can generally be cured by reversing the crystal and adjusting the H.T. and grid voltages.

An instrument, containing a coupling similar to those described, for converting a L.F. magnifier into a dual amplifier is now on the market.

lap, I use coils whose wavelengths have the following values :—

190 ms, 250 ms, 350 ms, 450 ms, 600 ms, 800 ms, 1,000 ms, 1,400 ms, 1,900 ms, 2,500 ms, 3,500 ms, etc.

When one of these transformers is used in the aerial, the next higher can be used as H.F. intervalve transformer if it is tuned by a ·0003 $\mu$F variable condenser, and the next lower can be used as valve to crystal transformer with a ·0012 $\mu$F variable condenser. This makes duplicate or triplicate sets of transformers unnecessary.

When it is not intended to use H.F. tuned couplings, such a large number of H.F. transformers is unnecessary if a series condenser, with which the wavelength of any coil can be reduced, is used. Only the following coils are then required—190 ms, 350 ms, 600 ms, 1,000 ms, 1,900 ms, 3,500 ms, etc.

It should be noted that as the tuned transformer is used as A.T.I., an ordinary H.F. transformer

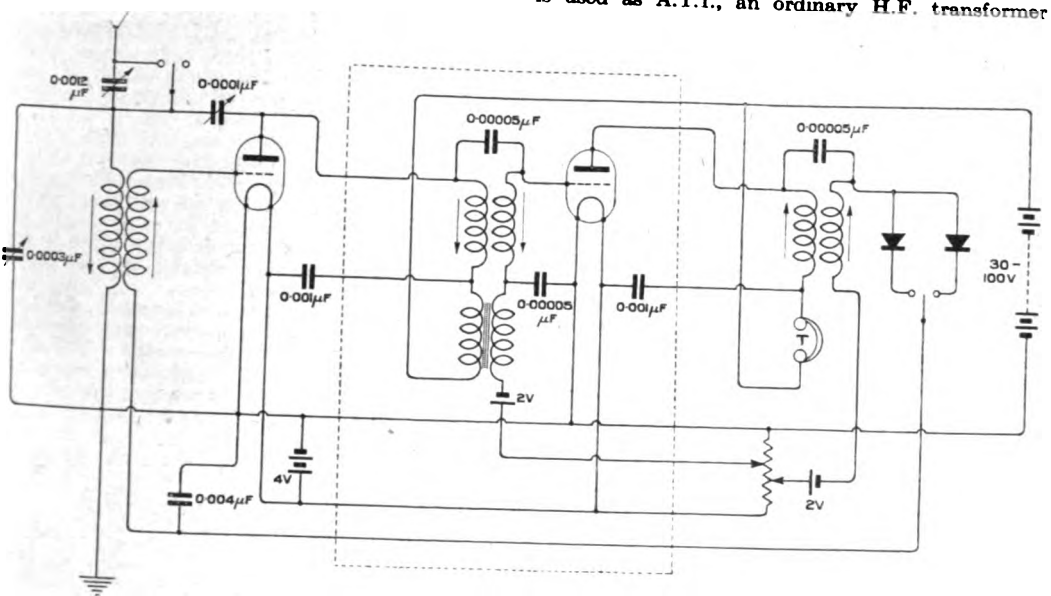


*Fig.* 4.

It is well-known that when the capacity of the parallel condenser in the aerial circuit increases, the voltage efficiency decreases. It is, therefore, not desirable to increase this condenser beyond about ·0003 $\mu$F. The capacity of the average aerial is also about ·0003 $\mu$F. Therefore, the capacity across the A.T.I. is about ·0003 $\mu$F. with the variable condenser at minimum, and about ·0006 $\mu$F. (or double) with the variable condenser at maximum.

The maximum wavelength of any coil is consequently about 1·414 (= $\sqrt{2}$) times its minimum wavelength.

If we try to work out a series of coils so that the wavelength of each coil is 1·414 times the wavelength of the coil below, we get a series of 15 values to include wavelengths from 150 to 27,200 ms.

This would not allow any overlap, and to get over-

wound with very thin copper or even resistance wire is quite useless.

My transformers have basket coils as primaries, and as a rough guide I give particulars of them in Table I. Lattice and other coils will no doubt be just as good.

As the secondaries carry hardly any current they may be wound with fine wire such as 42 S.S.C. It should be wound in narrow slots in a cardboard spider, so that it is as nearly as possible a single layer winding, which should then be boiled in wax.

It often happens that in manufacture a secondary develops a short circuit. This can be tested for as follows :—Tune in a C.W. station whose wavelength is of the same order as the wavelength for which the secondary is intended. Then hold the secondary near the aerial coil and retune. If the wavelength has increased, it is due to the

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TABLE I.

| Wavelength | S.W.G. | Inside diameter cms. | Outside diameter cms. | Turns. |
|---|---|---|---|---|
| 190 | 18 | NO DATA | | |
| 250 | 18 | | | |
| 350 | 18 | 5·2 | 13 | 30 |
| 450 | 18 | 7·4 | 18·5 | 36 |
| 600 | 22 | 5·2 | 13 | 46 |
| 800 | 22 | 7·4 | 18·5 | 54 |
| 1,000 | 26 | 5.2 | 13 | 90 |
| 1,400 | 26 | 8 | 20 | 140 |
| 1,900 | 26 | | | |
| 2,500 | 32 | | | |
| 3,500 | 32 | NO DATA | | |

self capacity of the coil under test which is then OK. But if the wavelength has decreased and tuning has become flat, the coil is faulty. The wavelength is decreased by the faulty coil on account of the fact that when the magnetic flux tends to thread the coil, eddy currents are set up which repel this flux, with the result that only a small fraction of the initial flux really threads the coil under test. This has the same effect as reducing the area of the air circuit through which the flux flows, and thus the apparent inductance of the aerial tuning coil is reduced.

As the H.F. transformers are tuned, a little extra capacity does not matter much, and they can be fitted to R valve plugs. If it is intended to interchange them with the aperiodic coupling, they should either be fitted with the low capacity plug previously described, or an adaptor should be made so that the R valve plug can be fitted to the low capacity socket.

It may seem rather strange to use a crystal detector in these days of valves, but when it is remembered that with one valve used for dual amplification, signals can be amplified 40 to 200

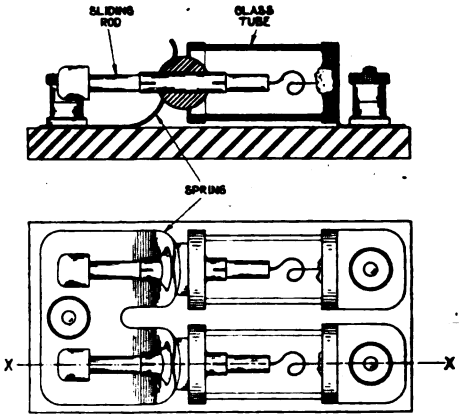


*Fig.* 5.

times, it will be seen that the valve is best employed as amplifier.

If two crystal detectors are used with a switch so that they can be set by comparison, no difficulty should be experienced with them, provided that they are quite rigid and fitted with good crystals such as treated galena, etc.

Fig. 5 shows a type of detector which is very stable. All unnecessary weight on the moving part should be avoided.

These circuits can be used for spark, C.W. and telephony, but are particularly good for telephony.

In conclusion I would like to thank PCGG for his regular transmissions, which have enabled me to make the experiments necessary to develop and perfect these circuits.

# On Heterodynes

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

(*Continued from page* 197).

IN the earlier instalments of this article descriptions were given of two arrangements of heterodyne using double coils, one for the tuning circuit and the other for providing the necessary reaction. It is possible, however, to employ other circuit arrangements, such, for example, as electrostatic reaction between the anode and grid circuits, instead of electromagnetic coupling. The general scheme of such reaction coupling is indicated in Fig. 12.

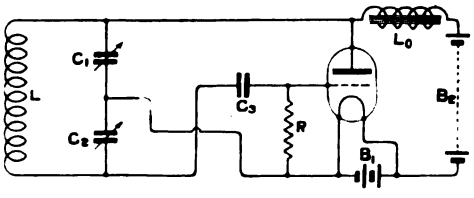


*Fig.* 12. *Heterodyne Oscillator with Electrostatic Coupling.*

In this diagram the inductance L of the oscillation circuit is shunted by two condensers in series, $C_1$ and $C_2$. One end of the inductance is joined to the anode of the valve, and the other to the grid, through a small condenser $C_3$, the function of which is solely to insulate the grid from the high positive voltage of the anode, which would otherwise be joined to it through the windings of the coil L, but at the same time it allows the passage to the grid of high frequency potentials from the coil L. The H.T. source, $B_g$, is connected to the anode as shown through the choke $L_0$, which offers a high impedance to the passage of radio frequency currents, and serves to confine those currents to their oscillation circuit, viz., L $C_1$ $C_2$. The grid is also joined to the filament of

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the valve through the leak resistance R, which prevents the accumulation of high negative potentials on the grid wires (by reason of grid rectification), while at the same time it does not draw away any appreciable amount of the available high frequency energy in the oscillation circuit.

The action of the two condensers, $C_1$ and $C_2$, in series may be likened to that of a potentiometer, since they serve to subdivide the total available potential across the oscillation circuit into two parts, one of which—the potential drop across $C_1$—is across the anode circuit of the valve, while the other—the potential drop across $C_2$—is applied to the grid of the valve. Hence any initial disturbance of the potential of the plate of the valve is communicated to the oscillatory circuit, *via* $C_1$, and results in the establishment of a pulse of current round that circuit, causing a potential difference to appear between the terminals of the condenser $C_2$, which is applied back to the grid of the valve. The sign of this potential change applied to the grid being opposite to that derived from the anode, the initial disturbance is reinforced, and steady current vibrations or oscillations are produced.

This arrangement of the circuit may be compared with the better known one, shown in Fig. 13, in which the subdivision of the potential across the oscillation circuit is made by the tapping from the filament to some suitable point along the inductance, thus dividing the coil into two parts, $L_1$ and $L_2$, corresponding to $C_1$ and $C_2$. The ratio of the values of the condensers $C_1$ and $C_2$ is therefore important, since it determines the ratio of the voltages in the grid and anode circuits of the valve. Stable oscillations can only be produced when this ratio lies between certain limits depending upon the valve in use. This ratio often changes somewhat with the wavelength of the oscillations, since the two condensers are shunted by other parts of the circuit—the anode condenser by the H.T. battery and choke coil, and the grid condenser by the grid leak resistance.

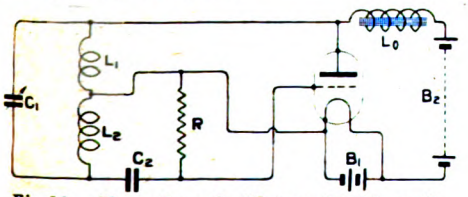


*Fig. 13. Heterodyne Oscillator with Magnetic Coupling.*

Using a circuit of this type, we can evidently build up a heterodyne with a single coil for each range of wavelengths, provided that we can vary two condensers in synchronism with one another. The simplest way of effecting this simultaneous adjustment is to mount two sets of vanes on one spindle in the manner indicated in Fig. 14, in which A and B are two sets of semi-circular fixed plates, mounted on opposite sides of the central spindle. The spindle carries two sets of moving vanes, $C_1$ and $C_2$, also mounted on opposite sides so that they interleave simultaneously with the two sets of fixed vanes. This double condenser would be connected in the circuit in the manner already indicated in Fig. 12, the spindle of the condenser being connected to the filament of the valve and the two sets of fixed plates being joined respectively to the anode and to the grid through the grid condenser $C_3$.

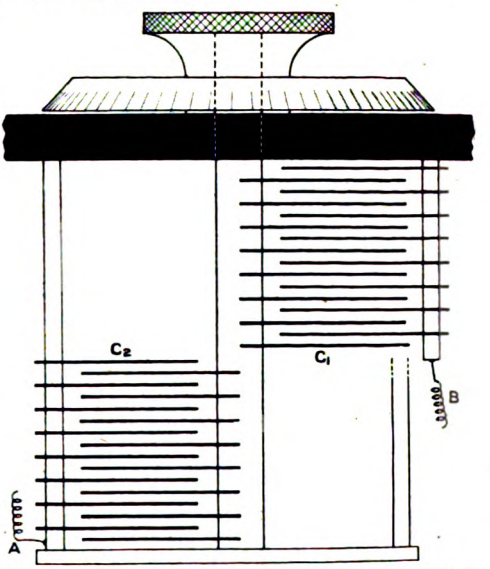


*Fig. 14. Arrangement of Double Condenser for Electrostatic Coupling.*

A double condenser of this type can be fitted into either design of instrument that has already been described in the earlier instalments of this article—Figs. 2 and 11—in place of the single variable condenser there shown. With this arrange-

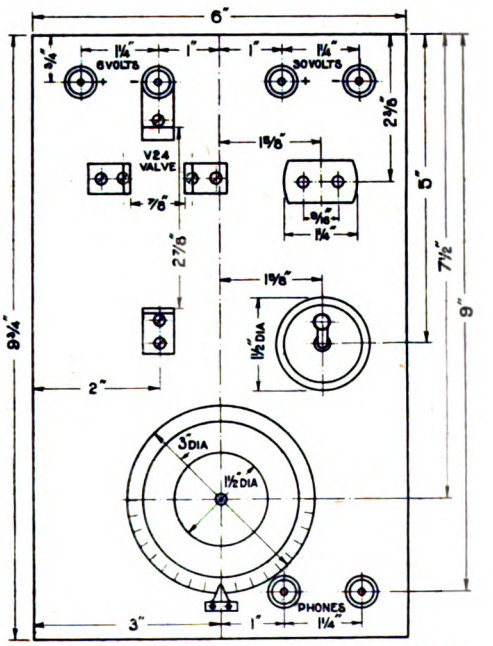


*Fig. 15. Plan of Top of Instrument No. 3.*

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ment the range switch is not required, and so can be omitted, together with one of the coil-holder sockets, since only one inductance is required for each range. In the space available in the instrument—the space occupied by the variable condenser of 0·0013 to 0·0015$\mu$F maximum capacity in the designs described above—it is only possible to fit a double condenser having a maximum capacity of each half of about 0·0006 microfarad. The effective capacity of the two parts, since they are joined in series across the coil when in use, is therefore only 0·0003 $\mu$F. A greater number of coils must be employed to obtain the same effective range of wavelengths as was obtained with the other arrangement. If a series of coils up to No. 1,000 the largest having an inductance of about 101,000 $\mu$F, is employed, the maximum wavelength obtainable will be just over 10,000 metres, since the maximum condenser capacity is much smaller than before. The values obtainable with "Burndept" coils are indicated approximately in Table III, and a suggested revised layout for the top of the instrument built on these lines is given in Fig. 15.

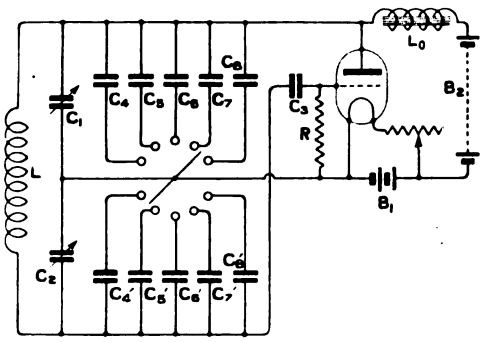


*Fig.* 16. *Simplified Circuit Diagram of Instrument No.* 4.

TABLE III.

Coils for Use with 0·0006 $\mu$F Double Condenser.

| Coil No. | Wavelength (metres). | |
|---|---|---|
| | Minimum. | Maximum. |
| 50 | 275 | 590 |
| 150 | 500 | 1,130 |
| 300 | 1,000 | 2,250 |
| 500 | 2,050 | 4,700 |
| 1,000 | 4,700 | 10,500 |

Many of the dimensions in this diagram are the same as the corresponding ones in Fig. 2, but where parts have been moved to new positions fresh dimensions have been given. The grid leak and condenser shown in Fig. 12 can be mounted up on the underside of the ebonite top of the instrument in any convenient position near the valve. Space will usually be found for these immediately under the valve-holder, so that they are quite convenient for connecting to the grid terminal. A condenser of about 0·00015 $\mu$F with a resistance of approximately 2 megohms will be found to function satisfactorily.

It should be mentioned here that the telephones which are often required for use in the heterodyne circuit can be used for the choke coil $L_0$ (Fig. 12) in the H.T. battery circuit. A choke of some sort is necessary here in order to prevent the battery forming a short circuit for the high-frequency currents, and a pair of telephones is usually quite effective for this purpose. With this connection, therefore, a pair of telephones should always be left in circuit, whether they are required for use as such or not, so that with this instrument it is

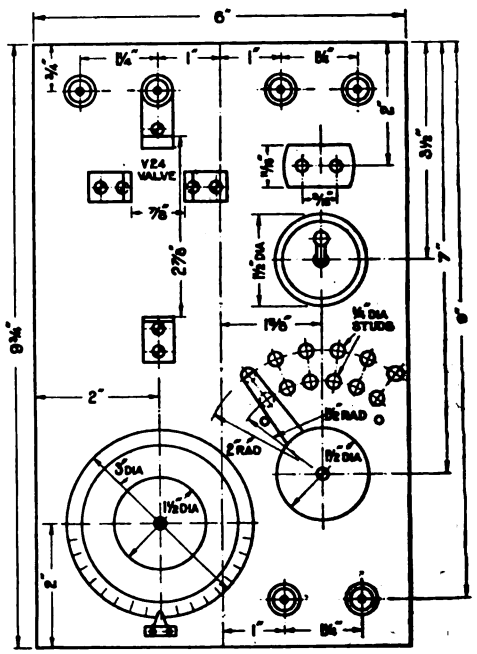


*Fig.* 17. *Plan of top of Instrument No.* 4.

unnecessary to provide the short-circuiting strap detailed in Fig. 8 in the second part of this article (page 195). Details of the valve-holder, etc., remain as set out in Figs. 4, 5, 6, 7 and 10.

This arrangement of instrument may be improved by increasing the range of capacity used with each

TABLE IV.

| Range. | Condensers. | Values, microfarads | Effective Maximum value of complete Condenser. |
|---|---|---|---|
| 1 | Variable - | 0·0006(max.) | 0·0003 |
| 2 | $C_4 = C_4'$ | 0·0005 | 0·00055 |
| 3 | $C_5 = C_5'$ | 0·001 | 0·0008 |
| 4 | $C_6 = C_6'$ | 0·0015 | 0·00105 |
| 5 | $C_7 = C_7'$ | 0·002 | 0·0013 |
| 6 | $C_8 = C_8'$ | 0·0025 | 0·00155 |

coil, thus augmenting the wavelength range and opening out the scale. Since the space available for the double variable condenser is already full, an increase of the effective capacity can only be

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obtained by connecting fixed condensers in parallel with the two parts of the variable condenser. The general scheme then becomes as shown in Fig. 16.

In this diagram $C_1$ $C_2$ and L remain as before, $C_1$ and $C_2$ being the two halves of the double variable condenser and $C_3$ and R are the grid stopping condenser and leak respectively. $B_1$ and $B_2$ are the filament and H.T. batteries respectively, with the choke coil $L_0$ in circuit with $B_2$. This choke may here, as pointed out above, be made up of a pair of telephone receivers. In parallel with the double condenser $C_1$ $C_2$ a number of fixed condenser units are shown. These may be connected in parallel with $C_1$ $C_2$ by means of the double switch Sw. Convenient values to give to these condensers are set out in Table IV.

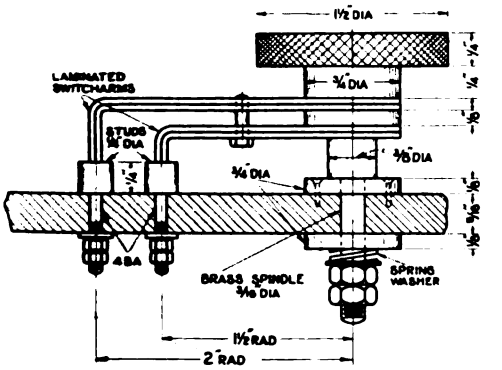


*Fig. 18. Double Contact Range Switch.*

The coils which are necessary with these condensers in order to ensure adequate overlapping of the various ranges are set out in Table V, which also gives the approximate wavelength range of the instrument with each coil employed for each point on the range switch which connects in the parallel condensers.

The plan of the top of an instrument designed on these lines is set out in Fig. 17, giving the leading dimensions. It will be noted that the general arrangement follows on the lines of those already described [instruments (1) to (3)], and that many of the parts are identical in detail. This remark applies to the clips forming the valve holder, to the condenser knob and scale, pointer and filament switch. A coil plug socket of the standard type should be secured in the position indicated, and no link for the telephone terminals is required (Fig. 8). The range switch is slightly different, since two sets of condensers require to be joined in circuit simultaneously. Details of a suitable switch are given in Fig. 18. It will be seen from the diagram in Fig. 16 that a double row of contacts is required. These can be arranged on the same side of the switch, as shown in Fig. 18, using a double laminated switch arm to bridge the successive pairs of contacts. The connection made to the spindle of this switch should be taken to the negative end of the valve filament, the first pair of contacts marked 1 in Fig. 17 being left free and the remaining five pairs connected to the fixed condenser in the manner indicated diagrammatically in Fig. 16. It should also be noted in connection with this diagram that no blocking condenser is required across the telephones and H.T. battery such as was used for the other designs. In fact, any such capacity, particularly across the telephones, is harmful in this arrangement and should be avoided in order to maintain the effective choking inductance of the telephones at as high a value as possible.

A further simplification of the electrostatically coupled arrangements here described is possible, and details of the method will be given in a further instalment of this article.

*(To be continued.)*

TABLE V.

| Coil No. | Wavelength Range (Metres) for Points on Range Switch. (1) | (2) | (3) | (4) | (5) | (6) | Total Range (metres). |
|---|---|---|---|---|---|---|---|
| 50 | 170–400 | 390–535 | 525–635 | 625–722 | 715–810 | 800–870 | 170–870 |
| 200 | 700–1,590 | 1,570–2,100 | 2,060–2,510 | 2,500–2,900 | 2,880–3,190 | 3,200–3,550 | 700–3,550 |
| 500 | 1,800–4,700 | 4,500–6,300 | 6,200–7,700 | 7,600–8,700 | 8,600–9,600 | 9,500–10,500 | 1,800–10,500 |
| 1,000 | 4,000–10,300 | 10,000–14,300 | 14,000–17,000 | 16,900–19,500 | 19,300–21,900 | 21,500–23,700 | 4,000–23,700 |

## The Wireless Society of London.

The last Meeting of the present Session will be held on Wednesday, June 14th, at 6 p.m., at the Institution of Electrical Engineers, Victoria Embankment, when an Address will be delivered by Sir Oliver Lodge, F.R.S.



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# Some Notes on Telephony Transmissions

THOSE who listened in to the broadcasting of the progress of the Carpentier-Lewis fight arranged by the *Daily Mail* in conjunction with the Marconi Company are in a position to appreciate some of the future possibilities of the service.

It is no exaggeration to speak of the Broadcasting Service in this country as heralding a new era in social progress, and the enthusiasm with which the public use of such a service has been received in the United States will undoubtedly be echoed in this country.

For some time past wireless amateurs have enjoyed the transmissions of The Hague, Writtle and the Eiffel Tower, as well as experimental transmissions of speech and music from a number of other stations, but the transmission in connection with the Carpentier-Lewis fight may be regarded as the first definite step towards the fulfilment of the promises made by the Postmaster-General.

The reception of the transmission on the night of the fight has been reported as extremely good from all parts of the country, and numerous messages of appreciation have been received by the *Daily Mail*. The station from whence the transmissions emanated is located at Marconi House, and in the vicinity it is possible to hear transmissions from this station with a crystal receiver and an indoor aerial of even as little as ten feet of wire.

Figs. 1 and 2 give two views of the transmitting apparatus at Marconi House.

On the extreme left of the pictures are the aerial tuning inductances, and below them the fixed condensers. The aerial ammeter is visible alongside the inductances.

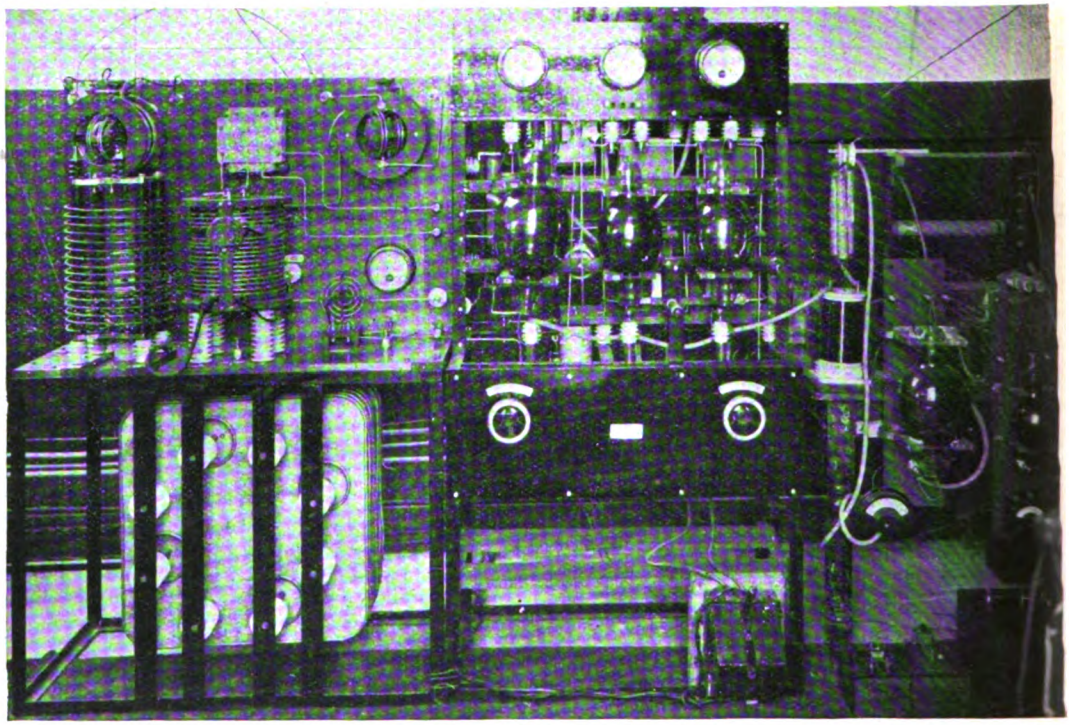

*Fig. 1.—The Marconi House Telephony Transmitter. This apparatus was used for broadcasting the progress of the Carpentier-Lewis fight.*

In the centre of Fig. 1 are three valves, that on the left being larger than the other two. This large valve is the main oscillating valve, and is of the Marconi-Osram type known as MT2. The other valves are rectifiers.

On the extreme right of Fig. 1 will be noticed two more valves, that on the left being rather smaller than the main oscillator and larger than that on the extreme right. These two valves constitute the control and sub-control valves.

When the microphone is spoken into the speech varies the current flowing through the microphone. This modulated current passes on to the primary of a small transformer, and so produces a second modulated current of a higher voltage in the secondary, which current varies the grid potential of the smaller of the control valves. This sub-control valve in its turn controls the valve imme-

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diately on its left, which is the main control valve, capable of handling a very large amount of energy. This valve is directly coupled to the main oscillator valve, so that it produces a very powerful modulation of the high frequency current flowing in the aerial circuit.

The source of supply for the transmitter is first obtained from the Charing Cross Power Station. This supply is transformed into alternating current of high frequency. A step-up transformer next raises the alternating current to a suitable voltage and supplies the two rectifying valves producing double wave rectification. Ripple is eliminated by means of chokes and condensers, and the quality of the speech depends very largely on the extent to which the radiated wave is freed from ripples produced by low frequency alternating currents, and speech of a poor quality with a rough tone is often attributable to this cause.

In an official announcement made regarding the broadcasting service it was suggested that in addition to the many other uses to which the wireless telephone might be put there was also the possibility that in the future one might listen to sermons on Sundays. Fig. 3 shows another suggestion which comes, of course, from America. Here we see a wireless receiver and loud speaker erected in a church which is not otherwise provided with a preacher, and in this manner the sermon preached in another church, perhaps many miles away, is picked up and made audible to the congregation by means of the loud speaker.

In Paris, the wireless telephone installation of the Eiffel Tower is under the direction of General Ferrié and Commandant Julien. Fig. 4, which is reproduced by kind permission of *La Nature*, represents a group at the Eiffel Tower on an occasion when the famous French singer, Madame Ivonne Printemps, broadcasted a recital by wireless telephone

In addition to the transmissions from the Eiffel Tower, experimental transmissions are conducted daily from the station at Sainte Assise, near Melun,

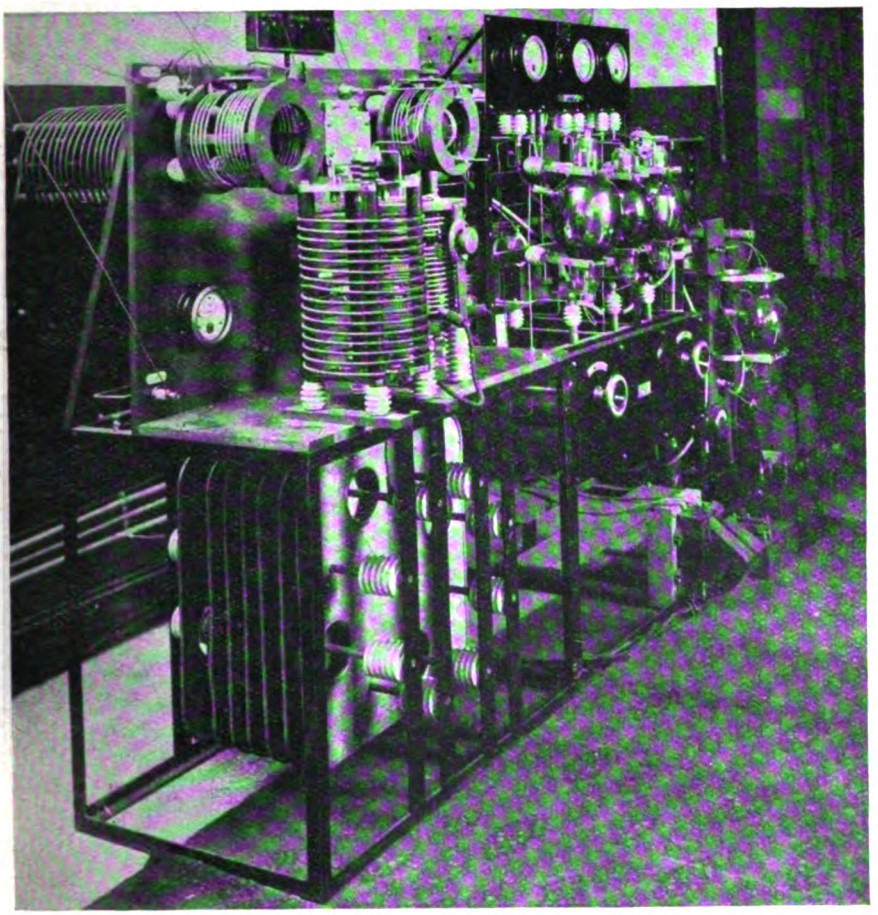

*Fig. 2.—A side view of the Telephony Transmitter installed at Marconi House.*



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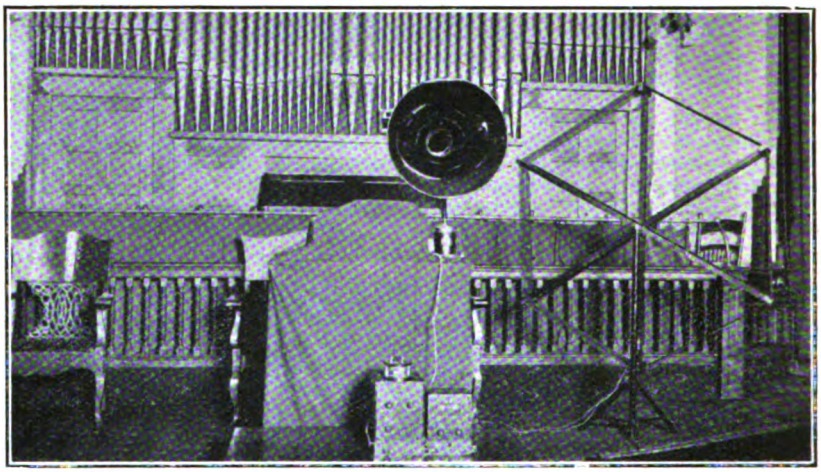

*Fig 3. Wireless Receiving Apparatus installed in a Church.*

whilst some very successful duplex transmissions have taken place between Bourget and Issy-les-Moulineaux. There are also experimental transmissions on a wavelength of 450 metres conducted by commercial companies in Paris. The transmissions from Eiffel Tower are conducted on a wavelength of 2,600 metres, and those from Sainte-Assise on 1,900 metres.

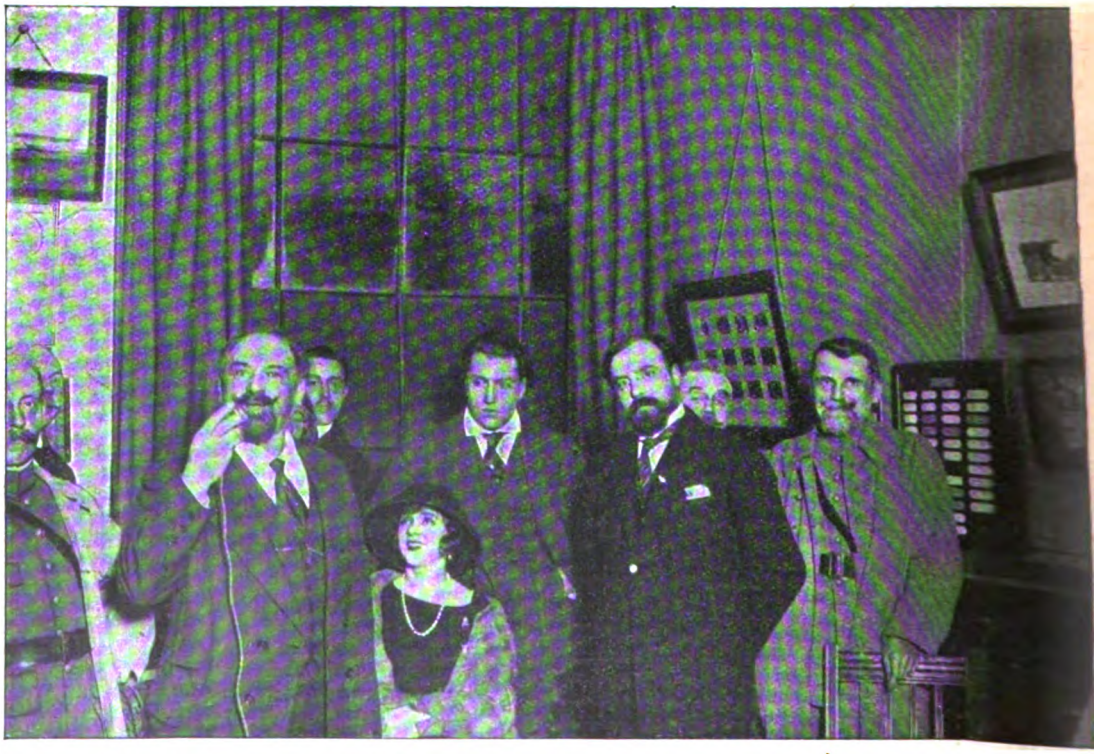

*Fig. 4.—A Wireless Concert at the Eiffel Tower. From left to right · The famous singer, Mme. Ivonne Printemps, M. Sacha Guitry, M. Laffont, Under Secretary of State, and General Ferrié.*

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# Experimental Station Design.

*These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*Although the information contained in the first few articles under this heading may cover ground already familiar to many readers, the succeeding instalments will advance by easy stages and in the course of the series the construction of an elaborate station will be evolved.*

## I.—THE AERIAL.

The first consideration in the construction of a station is the erection of the aerial. No definite instructions can be laid down, as circumstances are different in nearly every case, but the following points should be observed :—

(1) If there is a choice of site, select the one which is highest and least shut in by surrounding objects or hills. A church spire, tall chimney or other tall structure in the immediate vicinity of the aerial may impair its efficiency. The aerial should not be erected among a cluster of trees unless it can be well above them, neither should it be slung between walls and lower than the surrounding roof-tops. In considering a site it must be borne in mind that the ground level is really the mean level of the tops of the neighbouring objects.

(2) The running of the aerial parallel or near to telegraph or telephone wires should, if possible, be avoided. Such lines will absorb a good deal of energy that would otherwise be picked up by the aerial, and they may also give rise to noises during reception and even actual overhearing of telegraphic or telephonic messages may occur.

(3) With most aerials reception is not uniform in all directions, and if reception from a particular station is desired it is worth while, if possible, to arrange for that station to be located in the direction from which the aerial receives best. An aerial erected with its ends pointing N. and, S. and leading-in wires taken from the middle, will receive best from stations in northerly and southerly directions. Were the leading-in wires taken from the northerly end, reception would be best from stations situated to the N. If the aerial is to be steeply inclined the leading-in wires should be taken from the lower end.

(4) If a mid-point lead-in is to be taken from a level aerial, care must be exercised to see that connection is made at the exact middle. The leading-in wires must not be taken back beneath the aerial, but may either run down as vertically as possible or slope in a direction away from the aerial.

(5) The length of the aerial is controlled by the wavelengths on which it is desired to receive. For efficient reception on wavelengths between 200 and 1,000 metres the aerial should not be too long, and one of two wires not more than 70 feet each, is suitable. It is difficult to tune a long aerial to short waves, whilst a short aerial can be made to receive the longest waves, though perhaps not as efficiently as a longer one. A single wire may be used of, say, 100 feet, but the two-wire aerial will generally be found more convenient, as the small changes of inductance such as are provided in tuning instruments, will vary a two-wire aerial through a bigger wavelength range for a given variation of inductance. Where conditions permit it may be worth while to erect two aerials, one a small one of either of the above dimensions for short wave reception and another much longer and specially suited for long wave work. Fig. 1 shows various types of aerials for short wave reception, and Fig. 2 aerials of a larger type.

The method of supporting the aerial must be left to the reader, as conditions are so varied, but a few general cases are taken which may offer suggestions.

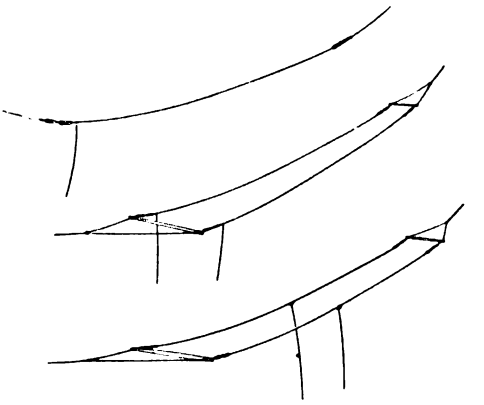

*Fig.* 1.

The use of a mast really necessitates some skill and experience in fixing, but with reasonable care and as much assistance as possible, the work can usually be successfully accomplished by the novice. It must be borne in mind that every foot in height that can be added to the aerial extends the range, and if any scheme can be devised to make it higher it is quite worth the extra trouble in carrying it out. Whilst admitting that good signals can be obtained on aerials fulfilling none of the desirable conditions mentioned above, it is always preferable to have maximum efficiency in the aerial, and so obviate unnecessary stages of amplification, with the attendant complications and manipulating

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difficulties. Where reception is to be carried out with the use of a crystal detector, a high outdoor aerial is strongly recommended, and the use of short indoor aerials, or aerials of the frame type, should not be adopted. It is sometimes argued that high aerials are more liable to produce in the receiver noises due to atmospheric disturbances and

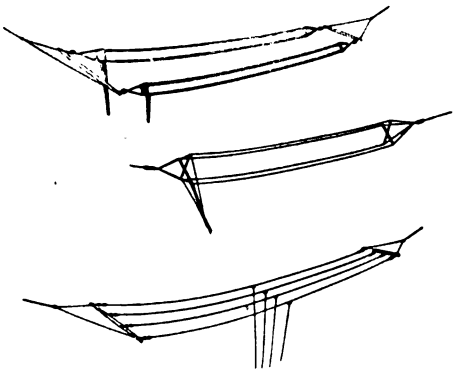

*Fig.* 2.

stray electrical discharges, but against this must be considered the fact that to produce a given strength of signal an indoor aerial will necessitate the use of amplifiers which, unless very carefully designed and of high grade manufacture, in themselves set up parasitic noises.

If one end of the aerial is to be a house-top it is better to terminate it on a small mast. If the roof is flat, the fixing of the mast is quite simple (Fig. 3), but if it is pointed, a chair must be made to rest across the ridge, as shown in Fig. 4. This chair must be strongly made to the design shown in Fig. 4, and should be held together with screws. Support should not be given to it by the top of the ridge, but by the sloping faces of the slates. A piece of thick felt or sacking placed across the ridge and extended down either side will prevent the chair from damaging the slates. This will also assist in keeping the chair in position, as vibration, due to the swinging of the aerial, and accompanied

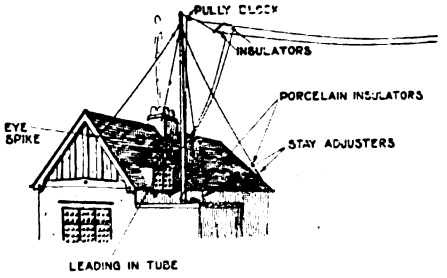


*Fig.* 3.

by side pull, may tend to push it out of position. This, as well as the mast and all other outdoor woodwork, should be given a protective coat of paint.

The mast must be guyed in four directions, so that it will stand vertical, irrespective of any pull that may be exerted by the aerial. Single No. 14 galvanised iron wire is usually strong enough for guys, provided the points of anchorage are further out from the base of the mast than the height of the mast itself. When only one set of guys is used they must be attached at a point about 6′ from the tip of the mast, in order to give plenty of support and to leave sufficient space to prevent the pulley becoming entangled in them. The question as to whether an additional set of guys is required is determined by any tendency the mast may have to bow. By using two sets of guys, one set at the middle and the other at the top, it is possible to give strength to a very slender mast.

Insulators must be inserted in the guy wires to prevent them acting as earthed aerials and so screening the main aerial, and these insulators will be seen in the figures.

A type, known as the "shell" insulator, is best for this purpose, as it has a high breaking strain and the shape of its flanges gives good insulation when wet. The insulators are inserted at either end of the guy wire so as to entirely insulate it, and should this insulated portion become more than 30 feet in length, other insulators should be put in, in the exact middle, if reception is to be carried out on wavelengths below 200 metres. The gauge of guy wire given above is suitable for masts less than 30 feet in height and supporting aerials not

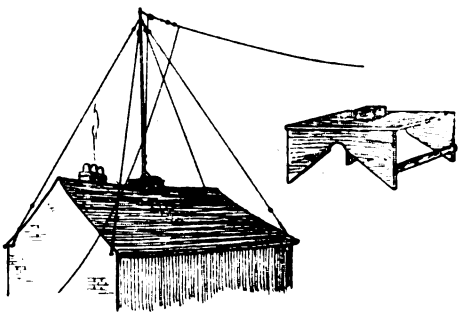

*Fig.* 4.

heavier than two 100′ lengths of 3/19 aerial wire. Where there is likely to be a greater pull due to a bigger aerial span, taller masts, or an aerial steeply inclined, heavier gauges must be used, such as single No. 8, 3/8 or 7/14. It is convenient to insert galvanised iron guy adjusters immediately below the bottom insulators in order that small adjustments can be made from time to time to keep the mast vertical. Guys and adjusters must be liberally treated with oil or grease before being left to the action of the weather.

For the points of anchorage of the guys malleable iron eye spikes should be used, driven home in the brickwork several courses down from the top. If a guy wire should pass round an iron gutter, a piece of felt must be wrapped round it at the point of contact to prevent risk of breakage due to friction and the acuteness of the bend. Tall, heavy masts cannot, as a rule, be supported by dwelling-house roofs, and if it is desired to have an aerial more than 20 feet above the roof, it is advisable to use a long mast reaching from the ground. For lightness the mast may consist of two poles spliced together and the dimensions of overlap, shown in Fig. 5, relative

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to the length should be adopted. Light 30-foot poles usually have a butt diameter of 7″ and a tip diameter of 3″ Specially selected poles may have less taper. The "McGruer" hollow spar mast is very useful for roof fixing, owing to its extreme lightness. For amateur stations, iron masts are not to be recommended. Those not experienced in roof work, and who call in the assistance of a local builder, will only need, however, to draw his attention to the fixing of the insulators in the guys.

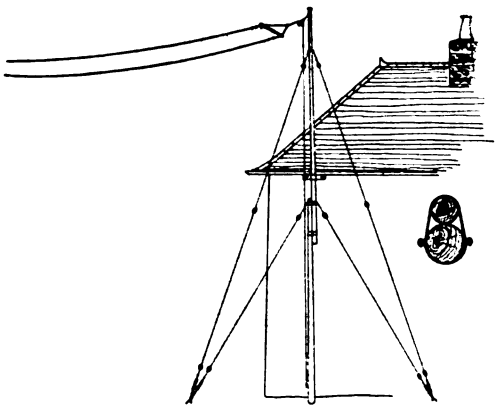

*Fig.* 5.

Masts erected from the ground and not standing alongside a house should also be guyed in four directions. Not only does this make a good strong job, but facilitates erection, for two sets of guys which are opposite to one another can be fixed and roughly made off to length while the mast is lying on the ground, and another set can be used for pulling the mast up. Fig. 6 shows a mast lying on the ground ready for erection, with a small pole for use as a derrick. Ladders are very useful for supporting the mast during raising, and will hold it in a partly raised position while adjustments are made to guys. All guys must be on, of course, before lifting the mast, and frequent adjustments made as it rises, in order that it will be more or less correctly guyed as soon as it reaches a vertical position. A sharp lookout must be kept that guys do not become entangled in trees or foliage, as the mast is raised, for any sudden tug exerted on the mast is apt to break it or cause it to lean at a dangerous angle. For amateur purposes the erection of such a mast will be rarely found necessary.

A circumstance that often arises is the fixing of a mast at the far end of a garden and where, in order to have the aerial of full length, it is not possible to arrange a back stay. Such a mast must be let several feet into the ground and a foundation made of boards having an area of at least 1 square foot, and also securely wedged at its base with pieces of timber to prevent any tendency it may have to move. To compensate for the pull of the aerial a forward strut, reaching in the case of a 30-foot pole to about 6′ up from the ground, must be provided. The base of the strut must have a secure foundation to prevent it driving further into the ground. It should be carefully fitted at the point of contact with the pole by making a slot about an inch deep and slightly undercut and giving the strut a wedge-like end.

The aerial may be of copper or bronze wire, and should preferably be light and flexible. A special wire has been made combining both lightness and flexibility by assembling a number of fine strands on a hemp core. Such an aerial, as well as being light and consequently having very little sag, is not so liable to kink, and moreover, possesses a large conducting surface, a property that is very desirable. Other varieties of wire may be used and, in fact, No. 18 bare copper is good enough. Stranded enamelled wire is sometimes used and possesses the advantages of having a large surface and not becoming easily oxidised.

Care should be taken in paying out the aerial wire. If it is in the form of a hank, loops should be taken from either side in turn, or, if it is on a reel, it should not be looped off, but the reel unwound. These precautions save a great deal of trouble by preventing kinks as the wire is being raised. Pulleys, of course, must be provided at the mast-heads. The ends of the wires are insulated from the halliards and the insulators should be very light to prevent sagging. For an ordinary single aerial, consisting of No. 18 wire, they may be made from scrap ebonite sheet and measure 2″ long by 1″ wide by ¼″ thick, holes being drilled in the ends to take halliards and aerial wire. The porcelain shell insulator has the advantage that, should it become damaged, the aerial will not fall. For the best results with two-wire aerials the spreaders must be at least 6 feet long and not too heavy. A light bamboo is suitable where there is not a great pull by the aerial wire. Alternatively, where more strength is required a wooden spreader with tapering ends will do. The greatest strain on the spreader is in the middle, and to prevent it bowing this must be its thickest part. Hollow spar spreaders

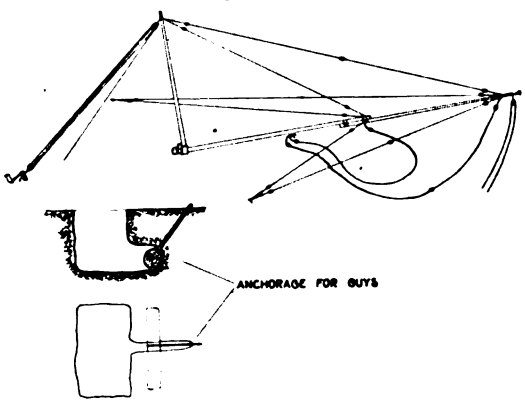


*Fig.* 6.

are also obtainable which are remarkable for their lightness. Fig. 7 shows spreaders, insulators, aerial and halliards.

Should a tree have been used for supporting the aerial, halliards must not be tied off taut to a point, or otherwise the swaying of the tree may break the aerial. This difficulty is overcome by fixing to the ground end of the halliard a weight sufficiently heavy to exert a pull that will keep

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the aerial taut and free to rise and fall with the movement of the tree. A bucket filled with earth will serve as this counterpoise. An endeavour should be made to keep the down leads of the aerial at least 6 feet away from walls or other earthed objects. Fig. 8 (b) shows a method of bringing the aerial wire into the operating room, and consists of an ebonite tube through which runs a brass rod. Alternatively a porcelain tube, Fig. 8 (a), may be used, but the lead will require renewing after a

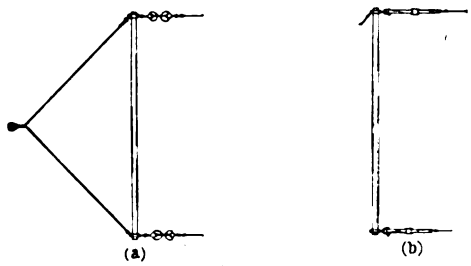


*Fig. 7.*

time owing to the perishing of the india-rubber. After the wire has entered the operating room it should pass almost directly to the instruments, and not wind about around walls for any distance.

It is not advisable that the instruments should be left permanently in circuit, and to guard them from damage by lightning an earthing switch must be arranged near to the point of leading in. A single-arm two-position switch, with china base and of good insulation, is suitable for the purpose. The aerial is brought to the switch arm and the lower contact joined to a wire making good contact with the earth, whilst a lead can be taken from the upper contact for connection to the instruments, thus serving either to put the instruments in circuit or to connect the aerial to earth.

In cases where it is not possible to erect an outdoor aerial, or where portability is required, indoor and frame aerials may serve for reception. The usual type of indoor aerial is distinct from a frame aerial, inasmuch as it has a free end which is not brought to the instruments and makes use of an earth connection. Its action is precisely that of the outdoor type, but it is of course, of smaller dimensions and does not possess all the advantages of an outdoor aerial. Such aerials are, in shape, similar to the outdoor kind, with the exception that they are much smaller and do not require so much attention to insulation. An aerial consisting of several well-spaced wires carried across a room, say, between picture rails on opposite walls and 20 feet in length will give good reception in an upstairs room when using valve amplifiers. A common error is that of running a wire round a room and leaving one end free and taking the other to the instruments, and operated in conjunction with an earth connection. This should not be done, as opposite sides of the aerial give equal potential fluctuations, due to the incoming ether strain, and consequently there is no current flow, and signals are only received on such aerials, because of distortion in the form of the wave. It would be better to convert such an aerial to the frame type by taking both ends to the instruments.

One way of arranging a frame aerial of fairly large dimensions is to drive brass screws into a wall at the four corners, wrapping them with insulating tape or putting over them small pieces of ebonite tube and winding with several turns of wire. The plane of the wall chosen must point in the direction of the station from which reception is desired. In the case of frame aerials this is more important than with the types previously described; in fact, if there is only a deviation of a few degrees, reception will not be obtained from the desired station. As it is improbable that a wall exists pointing in the precise direction, means should be adopted for making the plane of the aerial movable. One very good method of doing this is to wind the aerial on insulated pegs driven into the four corners of a door which, as it can be swung through 180° can be used for reception from any direction. It might be pointed out here that the marked directional effect of frame aerials has the advantage of providing for selective reception, and is very helpful in the elimination of jamming, for although two stations may be on exactly similar wavelengths, it is improbable that they will be situated in line with one another and the receiving aerial. The object of describing frame aerials made in this manner is to impress upon the experimenter the necessity for making the dimensions as large as possible, for if a wooden framework were used to support the turns of wire of equal dimensions to those provided by the above methods, it would be very cumbersome. Smaller frame aerials are, however, often adopted with a consequent loss of signal strength.

The number of turns wound on frame aerials depends on the wavelength on which it is desired to receive, and if reception is required over a long wavelength range, tappings must be made on the aerial so that varying portions may be connected in circuit. Wire of fairly good insulation must be used, and if the wavelength is to be short then single electric-light flex is suitable. For a square frame having sides 12 feet in length, three complete turns will tune from 280 to 600 metres, with a tuning condenser of maximum capacity 0·0005 mfd. When using a door 6 feet 6 inches in height

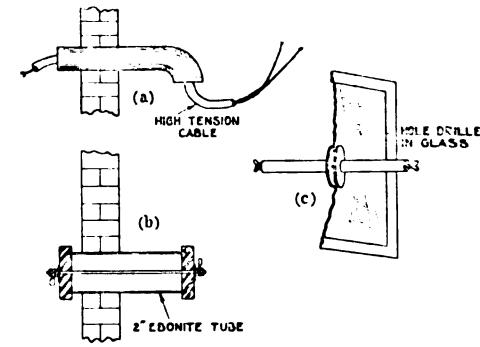


*Fig. 8.*

and 3 feet in width, nine turns of wire will approximately tune to the same range. With smaller frames finer wire will have to be used, because the many turns required would take up too much space if of the heavy wire. Frames having 3 feet sides will tune through this range, with 14 turns of D.S.C. wire wound with the turns touching. If

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there is enough space to wind the turns a little apart the frame will be more efficient, as the capacity of consecutive turns being less there will not be such a potential drop across the end of the coil. As spaced turns have less inductance than ones closely wound, one or two more extra turns must be added to give an equal wavelength. For smaller frames still, many more turns are required but the total length of the wire used should be a little less to compensate for the increased inductance given by the concentrating of the wire into a smaller space.

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# The Wireless Boom from the Traders' Point of View.

NOW that the Postmaster-General has made it possible for the general public to participate in the reception of broadcasted signals, it is obvious that there will very shortly be a boom in the sale of wireless apparatus. It is apparent that in a very short time the demand for wireless gear in all centres throughout the country will be very great and a vast new field of enterprise will be opened to electrical and allied traders in the sale of receiving equipments.

Last week's flood of enquiries to manufacturers indicate that the business possibilities have not been overlooked, and already arrangements are being made for the establishment of agencies throughout the country. This has made an immediate demand for specimen sets, and the wholesaler who has completed his designs and can at the moment quote firm prices and deliveries is reaping a big harvest of orders.

The class of gear for which there is likely to be a good market requires careful consideration and retailers are advised to carefully think over the results of the recent high power broadcast tests and the reception obtained in various parts of the country.

It would appear that equipments can be divided roughly into three classes. Firstly, low-priced crystal sets designed for the man of limited means, and for operation on wavelengths of 300 to 425 metres when connected to aerials of the dimensions at present specified by the Postmaster-General. There is considerable scope in the designing of such sets and the greatest difficulty would appear to be the devising of a crystal that can be put into the hands of a man inexperienced in its adjustment. Such a set might be fitted with a tuning buzzer, and even a tuned wavemeter circuit for the purpose of setting crystal and tuning adjustments to the broadcast wavelengths, so that all the user has to do is to adjust his crystal until he hears the buzzer signals strongly, and then improve the tuning arrangements to bring them up to a maximum strength. These simple sets must not have too many adjustments, and it is thought that with a view to cheapness as well as limiting the adjustments they need not be supplied with variable condensers, but something on the lines of the almost continuously variable sliding inductance or variometer may serve to tune through the wavelength range. Although the utmost economy should be exercised in the design of such sets, there is no reason why from an electrical point of view they should not be thoroughly efficient and attention might be drawn to the poor economy of supplying such sets with inferior telephone receivers. Crystal reception is difficult enough in the hands of the novice, but if his telephone receivers are not of the most sensitive type his troubles will be enhanced.

The second-class of set is the single-valve receiver so designed that additional amplification can be easily arranged without changing the existing internal connections. It is hard to say at the moment which type of valve circuit will be best for the reception of the broadcast telephony, and owing to the small amount of short wave work that has been done in this country, excepting, of course, by the experimental establishments of the larger manufacturers, little has been done in the design of valve receivers suitable for reception on wavelengths of the order of 350 metres. Amplifiers designed for coupling to these sets of both high frequency and low frequency should be available, so that they can be purchased from time to time and an elaborate set built up in easy stages.

The third class of equipment is that designed to be complete in every way with a full range of adjustments and equipped with amplifying and loud-speaking arrangements. The skill of the manufacturer will be put to the test in the production of this class of gear, because not only must it be capable of giving maximum adjustments, but it must also be so designed that it can be operated by the novice. This may seem contradictory but one suggestion is that the finer and more permanent adjustment be arranged behind a locked-up panel and one or two handles exposed on the front for final tuning and amplifier control.

In addition to the sale of complete sets much business can be done in the sale and the supply of component parts of materials and a retailer will show his worth to the experimenter by the completeness of his stock in this direction. Under this heading should be included the many gauges of instrument wire, ebonite of various dimensions, sliding contacts, brass rods, contact studs, condensers, terminals and screws. A perusal of the pages of the modern American wireless journals will open the eyes of the British retailer to the many varieties of gear which he will be expected to stock.

Another class of business that will immediately open up as a result of a boom will be in assisting the general public in the erection of their aerials. Roof work is always difficult especially to a man unaccustomed to it, and a dealer who has to hand all the necessary components for aerial erection and understands how to set about this class of work is likely to do good business. The aerial being the first part of the outfit which is likely to be required by the customer taking up wireless, the firm that supplies and fixes it will no doubt secure most of the business with regard to the future needs of the station.

A fundamental consideration in the supply of wireless gear is that the retailer carries on his staff a man thoroughly acquainted with wireless telegraphy, who is in a position to advise the novice and solve the many difficulties he may encounter.

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# Wireless Societies of the United Kingdom

*The following is a list of Wireless Societies in the United Kingdom, together with the addresses of the Secretaries. It is thought that this list will prove of general interest, especially to those beginning Wireless and requiring the assistance which the Societies are in a position to give them.*

Aldershot and District Wireless Society, Farnborough Road, Farnborough, Hants.

Anerley Wireless Society, 14a, Weighton Road, Anerley.

Barrow and District Amateur Wireless Association, 19, Niger Street, Barrow-in-Furness.

Bishop's Stortford College Wireless Society, The College, Bishop's Stortford.

Blackburn (Y.M.C.A.) Wireless Club, c/o Y.M.C.A., Blackburn.

Bolton Wireless Society, 9, Raimond Street, Halliwell, Bolton.

Bournemouth and District Radio Club, 2, Iris Road, Winton.

Bradford-on-Avon Wireless Society, 4, Ivy Terrace, Bradford-on-Avon, Wilts.

Birmingham Experimental Wireless Club, 110, Ivor Road, Sparkhill, Birmingham.

Blackpool and Fylde Wireless Society, 6, Seventh Avenue, South Shore, Blackpool.

Bradford Wireless Society, 85, Emm Lane, Bradford.

Brighton Radio Club, 68, Southdown Avenue, Brighton.

Brighouse and District Wireless and Experimental Society, Oak View, Rayner Road, Brighouse.

Bristol and District Wireless Association, 5, Pembroke Vale, Clifton, Bristol.

Bristol Wireless Association, Portishead Rectory, Somerset.

Burton-on-Trent Wireless Society, 66, Edward Street, Burton-on-Trent.

Cambridge and District Wireless Society, 107, King Street, Cambridge.

Cambridge University Wireless Society, Post Office, 16, Trumpington Street, Cambridge.

Cardiff and South Wales Wireless Society, 16, Adamsdown Square, Cardiff.

City and Guilds Wireless Society, City and Guilds Engineering College, Exhibition Road, London, S.W.7.

Colchester Wireless Society, 10a, East Hill, Colchester.

Coventry Wireless Association, 14, Coundor Road, Coventry.

The Corinium Wireless Society, The Old Vicarage, Cirencester.

Cowes and District Radio Society, Pretoria, Castle Street, East Cowes, I.O.W.

Croydon Wireless and Physical Society, Meadmoor, Brighton Road, Purley, Surrey.

Cricklewood and Brondesbury Radio Club, 213, Fordwych Road, Cricklewood, N.W.2.

Crosby, Waterloo and District Wireless Society, 6, Cambrudge Road, Crosby, Liverpool.

Dartford and District Wireless Society, 84, Hawley Road, Wilmington, Dartford.

Derby Wireless Club, "The Limes," Chellaston, Derby.

Dewsbury and District Wireless Club, Willow Grove, 34, Lee Street, Ravenscourt, Dewsbury.

East Dorsetshire Wireless Society, Abbotsford, Serpentine Road, Poole.

Dundee and District Amateur Wireless Society, 33, Cowgate, Dundee.

Ealing Wireless Society, 52, Uxbridge Road, Ealing.

East London Radio Society, King George's Hall, East India Dock Road, E.14.

Edinburgh Wireless Club, 9, Ettrick Road, Edinburgh.

Epsom and District Amateur Radio Society, Cinema Royal, Epsom.

Exeter and District Wireless Society, 22, South View Terrace, Heavitree, Exeter.

Falmouth Wireless Club, The Old Grammar School, Killigrew Street, Falmouth.

Felkirk and District Radio Society, c/o The Old High School, Felkirk.

Fife and Distjict Wireless Society, Walkers Buildings, Dunbeath, Methil, Fife.

The Folkestone and District Wireless Society, 8, Longford Terrace, Folkestone.

The Gravesend Wireless Experimental and Model Engineering Society, c/o Globe Hotel, Gravesend.

Grimsby and District Radio Society, 256, Welhome Road, Grimsby.

Guildford and District Wireless Society, Ivydene, Guildford Park Road, Guildford.

Glasgow and District Radio Club, 7, Queen's Gardens, Glasgow.

Glevum Radio and Scientific Society, Burfield, St. Paul's Road, Gloucester.

Gloucester Wireless and Scientific Society, 1, Jersey Road, Gloucester.

Wireless Society of Greenwich, 18, Blackheath Rise, S.E.

Halifax Wireless Club, Y.M.C.A., Clare Hall, Halifax.

Handsworth Wireless Society, c/o The Y.M.C.A., Handsworth.

Hartlepool and District Wireless Society, 33, Grange Road, West Hartlepool.

Hounslow and District Wireless Society, Council House, Hounslow, Middlesex.

Huddersfield Wireless Society, 35, Bk. Cole Street, Aspley, Huddersfield.

Wireless Society of Hull and District, 16, Portobello Street, Holderness Road, Hull.

Ilford and District Radio Society, 12, Seymour Gardens, Ilford.

Ilkley and District Wireless Society, Lorne House, Richmond Place, Ilkley.

Ipswich and District Wireless Society, 46, Grove Lane, Ipswich.

Kensington Wireless Society, 2, Hollywood Road, South Kensington, S.W.10.

Kidderminster Wireless Society, 33, St. George's Terrace, Kidderminster.

King's College Wireless Society, King's College, Strand, W.C.2.

*The list of Societies will be completed in our next issue.*

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# Four-Electrode Valves and Their Circuits

(*Concluded from page* 235.)

**Captain Donisthorpe** (*in reply communicated*).

With regard to the remarks made by Mr. Scott-Taggart, I would like to state that I appreciate some of the difficulties which he has mentioned; but it was not my intention to deal with the commercial side of the question. I have only wanted to put before our members, who are amateurs, the general principles and workings of the circuits for the various types of four-electrode valves. But perhaps I might briefly go over this subject and tell them that by using one of these amplifiers shown at the meeting, economy is obtained; and another great point to be considered is the simplicity with which it can be used. This instrument can be put straight on to any sort of simple receiver, and results obtained without the manipulation of copious adjustments. The amplification obtained is not absolutely as strong as an amplifier with three valves, but nevertheless one gets a high percentage of amplification.

It is regretted that the Figure referred to by my colleague was incorrect, inasmuch as a condenser has been omitted, as he pointed out. The other question deals with the position of the transformers in the circuit. This is a question relating to the design of the particular instrument under consideration, so that no useful purpose will be served in going into the matter, as it is the general action of the circuits I wish to bring to our members' notice, and not constructional details of one particular type of apparatus.

With regard to Mr. Phillips's remarks, this instrument is not used for continuous wave reception by itself, but a separate heterodyne is employed in connection with it. It is possible to pick up C.W., and the reaction effects between the high-frequency transformer show a slight tendency to produce self-oscillation; but the adjustment can be made.

With regard to Mr. Child's remarks, this instrument is quite capable of picking up telephony, and will give you very satisfactory results. One point to be borne in mind when working this instrument in connection with telephony is to work it as far as possible over the oscillation point.

With regard to our President's remarks, I would state that one of these valves has been in continuous use for eight months.

# Wireless Broadcasting.

## THE CO-OPERATION OF FIRMS.

THE following official statement regarding the meeting of representatives of wireless firms called by the Postmaster-General on Thursday, May 18th, was made after the conclusion of the meeting:—

"A meeting of representatives of firms engaged in the manufacture of wireless apparatus was held this morning at the General Post Office to discuss the arrangements to be made to carry into effect the scheme recently announced by the Postmaster-General in the House of Commons for broadcasting matter (including music) by wireless sets.

"It was recognised generally that, in order to avoid interference, broadcasting stations would have to be very limited in number. Some of the representatives thought that not more than eight could work simultaneously in Great Britain, using the power (1½ kilowatts) and the band of wave-lengths (350-425 metres), allowed for the purpose, without such interference as would produce practical chaos. It was also recognised that the provision of a suitable daily programme at the various stations would be expensive, and that it was important in the interests both of the public and the manufacturing industry that the continuity of the service and the maintenance of a high standard in the programme should be ensured. The best means of attaining these objects seemed to lie in co-operation among the firms concerned, and it was suggested that one or possibly two groups should be formed, which should become responsible, both financially and otherwise, for the erection and maintenance of the stations and the provision of suitable programmes. In accordance with these suggestions it was arranged that the representatives of the various firms should collaborate in the immediate preparation of a co-operative scheme, or at the most of two such schemes, for consideration by the Post Office authorities."

All further arrangements for the service will probably be made in agreement between the various representatives of firms, and as we go to press we learn that the first meeting with this object in view is called for Tuesday, May 23rd.

# Notes

## WIRELESS POSITION-FINDING FOR AIRCRAFT.

Since October of last year a wireless "position-finding" system has been under trial to enable air pilots to ascertain their position when flying on the Cross-Channel airways. This system has, on several occasions, proved to be of particular advantage in adverse weather conditions, and has been introduced as a regular feature of the civil aviation wireless service. It is a further development of wireless direction-finding which, during the past two years has proved of such great value to air navigation.

Until last October direction-finding work was carried out only by the Civil Aviation Wireless Station at the London air port of Croydon, and was limited to giving a pilot his compass bearing from that station. The Direction Finding station at Pulham Airship Base, Norfolk, has been successfully operated as the second station of the system during the past six months, thus enabling two bearings to be taken simultaneously upon a single aircraft, and its position determined by plotting the bearings upon a chart, the point of intersection giving the aircraft's position.

Direct intercommunication between Croydon and Pulham is effected by radio-telephony, and the pilot can be informed of his position with a high degree of accuracy under normal conditions. The radius of action for giving position is approximately 200 miles from the control station, which in this case is Croydon. Although primarily designed for radio-telephony, the system is equally adaptable for radio-telegraphy; the change-over being carried into effect by a simple switch in a few

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seconds. The position can normally be given within two minutes. Similar facilities can be afforded from Croydon to aircraft engaged on inland flights and services.

Several instances have already occurred in cases of fog and storm where pilots have been informed of their position and enabled to reach their aerodromes in safety. The most noteworthy occasion was in February last, when an aeroplane flying over the airway between Paris and London, was navigated entirely by wireless, the pilot seeing the ground only on one occasion for a few minutes.

Pilots and navigators have been strongly urged in a Notice to Airmen, which has just been issued, explaining the working of the system to make a practice of utilising on every flight this important aid to navigation as the experience gained in the use of position-finding in good weather when pilots should be able to check the accuracy of the positions, will add to their confidence and proficiency in using the system when flying in bad weather.

### Public Appreciation of Wireless.

The above picture shows the crowd which assembled outside the establishment of a wireless manufacturer to get first-hand the result of the Carpentier-Lewis fight.

### Wireless Station Re-opened.

The wireless station at Grimsby was re-opened for commercial traffic on May 17th. The hours of working are 8 a.m. to 11 p.m. B.S.T., on a normal wavelength of 600 metres. The call sign is **GKZ.**

### P.M.G. Licenses in India : New Regulation.

We are informed by the Director of Wireless, Ports and Telegraphs Department, India, that the Postmaster-General has agreed that a First and Second Class Certificate of Compentency, issued by the Department of Ports and Telegraphs, India, will be accepted in lieu of the corresponding class issued by the Postmaster-General, London, as qualifying an operator to work the wireless apparatus on a ship registered in Great Britain. Similarly, certificates issued by the P.M.G. are accepted on ships registered in British India .

## Calendar of Current Events

**Saturday, May 27th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
Field Day.

**Sunday, May 28th.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, May 30th.**

Transmission of telephony at 8 p.m. on 400 metres by **2MT**, Writtle, near Chelmsford.

**Thursday, June 1st.**

LIVERPOOL AMATEUR WIRELESS SOCIETY.
Open Night and Soiree.

BRADFORD WIRELESS SOCIETY.
Lecture by Mr. H. F. Yardley.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.
First Annual Meeting.

**Friday, June 2nd.**

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—Lecture by Mr. F. L. Hogg.

BRADFORD WIRELESS SOCIETY.
Lecture by Mr. H. F. Yardley.

**Saturday, June 3rd.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
Half-day visit to Aerodrome and Wireless Station, Croydon, by kind permission of the Air Ministry (Members wishing to join this party should advise the Secretary at once).

**Tuesday, June 6th.**

THE INSTITUTION OF ELECTRICAL ENGINEERS.
6 *p.m.*—Savoy Place, Victoria Embankment W.C.2. "The Performance of Radio-telegraphy Transmitters with Special Reference to the Installation at the North Foreland," by Capt. Norman Lee. Also a Demonstration of a Dynamic Model of Tuned Circuits, by Professor C. F. Jenkins.

THE WOLVERHAMPTON DISTRICT WIRELESS SOCIETY.
8 *p.m.*—At 26, King Street, Wolverhampton. "The Electron Theory," by Mr. Blakemore.

**Wednesday, June 7th.**

NORTH ESSEX WIRELESS SOCIETY.
At the Technical Exhibits Tent, Essex Agricultural Show, Chelmsford. Demonstration of Wireless. (Also on the 8th.)

**Thursday, June 8th.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
"The Thermionic Valve," by Mr. J. F. Turner.

**Friday, June 9th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—"Reception of Wireless Telephony," by Capt. F. A. Whitaker, R.E.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—Informal Meeting.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### North Middlesex Wireless Club.*

This Club has recently acquired a Townsend Wavemeter, which we have had calibrated by the National Physical Laboratory.

Although this instrument was primarily intended for the use of our members, it has occurred to our Committee that we could be of use to the Secretaries and members of other Societies by undertaking to calibrate their wavemeters against ours. A small fee would be charged for this, and the work would be done by a qualified member of this Club.

The Hon. Secretary, Mr. E. M Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21, will be pleased to give further details to anyone interested on receiving an application through the Secretary of his Society.

### Croydon Wireless and Physical Society.*

Hon. Secretary, Mr. B. Clapp, "Beadmoor," Brighton Road, Purley.

At a meeting of the Croydon Wireless and Physical Society held at the Central Polytechnic, Croydon, on Saturday, May 6th, 1922, one of the members of the Society, Mr. H. R. Rivers-Moore, B.Sc., A.M.I.E.E., gave a lecture on the "Improvement of Wireless Receiving Apparatus in Recent Years," starting with the magnetic detector and finishing with the modern valve apparatus. At the request of the lecturer the lecture was interspersed with questions from members, which led to some very keen discussions. The members agreed with one accord that they had spent a very enjoyable evening and passed a very hearty vote of thanks to the lecturer. The fact that Mr. Rivers-Moore is a member of the Society made the lecture all the more interesting.

### Manchester Wireless Society.*

May 7th. High Power Station.—A small working party of 12 members began the preliminary work for the erection of the masts. This consisted of wire splicing and serving and joinery.

Mr. Brown, of "Redbrook," Baguley, has kindly placed his coach-house and loft at the disposal of the members, an offer which is greatly appreciated, otherwise, shelter from inclement weather would have been rather scarce.

In view of the fact that amateur wireless is being boomed by reason of the new broadcasting facilities, interest has been centred around the Society's activities at Baguley, and numerous enquiries are being received as to the nature of the work in hand, not a few of the "wirelessly curious" having visited the site, in order to obtain first-hand information.

The work will be carried out as speedily as possible and, weather permitting, should be complete in a few week's time.

Hon. Secretary, Mr. Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester.

### Sheffield and District Wireless Society.*

Hon. Secretary, Mr. L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

The closing meeting of the season 1921-22 was held at the Department of Applied Science, St. George's Square, Sheffield, on the 28th April, when Mr. F. O. Hunt, of the Sheffield University, gave a most interesting and instructive lecture on "Anti-Submarine Research Work," illustrated by lantern slides and diagrams.

In a masterly and lucid manner the lecturer, while avoiding the disclosure of any official secrets, explained many of the devices used for the detection, obstruction and destruction of submarines and demonstrated the action of some of them by means of apparatus.

He held his audience for several hours, and interest was so keen that the discussion had to be postponed until the 5th inst. There was a large attendance at both meetings and Mr. Hunt was cordially thanked for his valuable paper.

### Plymouth Wireless and Scientific Society.*

At the meeting held on Wednesday, May 3rd, a lecture and demonstration on the "Construction and Wiring of the Three-Valve H.F. Set," was given by Mr. Heal. With a set showing very fine workmanship and giving excellent results, the lecturer was able to deal with his subject in a very practical manner. Very useful hints were given on drilling ebonite and on French polishing.

On Wednesday, May 10th, a lecture was given on "The Armstrong Supersonic Heterodyne," by Mr. P. Arbery. This proved a very interesting and useful subject, as the method provides an easy way out of the great difficulties attending the reception and amplification of short waves. The method of heterodyning the incoming oscillations in such a way as to produce a beat note of radio-frequency and then passing these waves through an ordinary long wave H.F. amplifier is certainly very ingenious. Altogether this lecture should prove one of the most useful we have yet had.

It has been decided to abandon the ordinary weekly meetings during the summer and to replace them by frequent field days.

Full particulars of the Club may be obtained from the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

### Kensington Wireless Society.*

A General Meeting was held at 2, Penywern Road, Earl's Court, on May 4th, at 8.30 p.m., the President, Captain Donisthorpe, in the Chair, when Mr. J. F. Turner, of the Wandsworth Wireless Society, gave a lecture on the "Inner Mysteries of Thermionic Valve Manufacture."

Mr. Turner dealt with the subject in a very masterly manner, and gave very interesting details of the many processes through which a valve passes during manufacture.

A number of valves of various types, some in process of manufacture, and other completed, were exhibited.

Some discussion ensued, and a number of questions were asked.

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A very hearty vote of thanks was tendered to the lecturer, and the President welcomed on behalf of the Club, the visitors from the Wandsworth Wireless Society, and the Kew and Richmond Wireless Society.

He stated that he thought all Clubs, and more especially the smaller ones, could assist each other very materially by exchanging lecturers and by visiting each other.

Mr. Child then gave constructional details of a type of H.F. transformer with which he had been experimenting, and this again led to some discussion.

The meeting was then adjourned.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, South Kensington.

### Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The weekly meeting of the above Society was held at the Y.M.C.A., Woolwich, at 7.30 p.m., on Wednesday, May 10th. The proposed 3-valve set having been constructed by Mr. Beeson and friends, was exhibited to the Club. Mr. McPherson and Mr. Beeson explained the principle and construction of the set. The idea was to use the first and second valve as H.F. amplifiers and the third as a detector. A feed back was made from the third valve to the first valve with L.F. intervalve coupling. This could be plugged in or out at will with this arrangement, which was virtually a two-valve H.F., one valve detector and one valve L.F. magnifier. Three valves were made to function as four. The set was tested and excellent results were obtained on the shorter waves, including some very fine telephony, but difficulty was found in getting long wave stations. Mr. Beeson agreed to give the set a prolonged test till next week, in order to get the best adjustments of condensers and resistances and transformers. A hearty vote of thanks was offered to Messrs. Beeson, Vincent and Frazer for their kindness in putting the set together.

It was resolved to have an exhibition of amateur home-made wireless apparatus at the monthly meeting at the Polytechnic at an early date. Several members offered to lend and demonstrate various pieces of apparatus.

All interested in wireless are invited to come then and inspect some of our various "gadgets."

### The Wireless and Experimental Association.*

A very busy evening was spent on Wednesday, May 10th, at the Central Hall, Peckham, especially on business, made all the more urgent through the coming boom. It was decided to institute a campaign to get in touch with as many of the newcomers to the art as possible, firstly, for their gain, and secondly, for the general benefit by showing them how to avoid causing interference. The Club set will be brought into commission to show fresh members how simple reception can be made, and to give them confidence to produce similar results. The broadcasting concession was reviewed from every angle, as several members with powerful amplifiers were wondering what would happen if a neighbouring one and a half kilowatt set were to start up on full power. Mr. Ford, one of the members, exhibited and described a tuner of his own construction, embodying a standard three-coil holder, altered to make the adjustments much finer and at the same time, more convenient.

Considerable interest was aroused by a discussion on the balanced crystal receiver, more usually known as the Marconi Type 16 Crystal Set, and questions were asked if it were possible to utilise a perikon combination instead of the carborundum.

The Chairman then asked if anyone could give further information on some of his observations. They were to the effect that when receiving a telephony transmission, where D.C. was used in the transmitter, the generator hum occurred right on top of the speech and could not be cut out without weakening the speech. In the case of a transmitting station using rectified A.C., the generator hum did not occur on the same adjustment as that best for speech, but at several degrees on the condenser away from the correct tuning. As this effect had not been noticed, members were asked to make some observations with a view to getting to the root of the trouble.

We still have plenty of room for more members who are invited to put in an appearance at any of our meetings, or to write to the Assistant Secretary for particulars at 21, Troughton Road, Charlton, S.E.7.

### The Leicestershire Radio and Scientific Society.*

The bi-monthly meeting was held on Monday, the 8th inst., at Headquarters. The President, Cyril T. Atkinson, Esq., being in the Chair.

The usual routine business was gone through, one new member being accepted. The President then made a few remarks on behalf of the Committee and himself, apropos to the increase in the number of "Aether Canaries" noticeable in the district this spring, and urged all members of the Society to do their best to prevent this misuse of apparatus by themselves or by others when possible.

The lecturer for the evening, Mr. E. Masters, was then called upon to give his paper on "The Theory of the Valve," which he did in his characteristic clear style. He dealt with the early experimenters' work from Edison *via* Sir. J. J. Thomson and others, to Fleming and De Forest, and very clearly described what goes on in the older type of two-electrode valve. Curves and diagrams were used to illustrate and elucidate points often very difficult to clearly understand.

The meeting closed with the according of a very hearty vote of thanks to the lecturer for his exceedingly interesting discourse.

All communications to be addressed to the Hon. Secretary, Mr. J. R. Crawley, 269, Mere Road, Leicester.

### Hounslow and District Wireless Society.*

On Thursday, May 11th, Mr. Gordon Fryer, L.D.S., R.C.S. Engl., our Vice-Chairman, promised to deliver a lecture entitled "The Elementary Theory of the Valve," but owing to the reports in the daily press on the same day on broadcasting the fight, it was decided to postpone his lecture. The lecturer had brought along a quantity of apparatus, for which the members were very thankful, as quite a number of notables in the district called in to see if we could get the result. This Mr. Fryer did very successfully with four valves and a loud speaker, and everyone heard Marconi House. At the end of the meeting a hearty vote of thanks was passed to Mr. Fryer. Mr. Fryer will deliver his lecture next week.

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A visit is being arranged to Croydon Aerodrome and the Slough Experimental Station.

If any gentleman is at all interested in wireless and would care to join *our* Society, the Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow, will only be too pleased to supply particulars.

### Ilford and District Radio Society.

Thursday, May 4th. After certain preliminary business in connection with the accounts of our recent concert had been satisfactorily settled, the Chairman, (Mr. H. Lassman, called upon Mr. A. E. Gregory to open a discussion on "Low Frequency Amplification." All speakers were limited as to time and considerable amusement was caused by the rapidity with which sketches were drawn upon the blackboard. Resistance-coupled low frequency amplification excited much discussion, but argument became quite heated when several members got on to the causes and elimination of the "howling" which usually accompanies multi-valve amplifiers. Many varied devices, some of them totally opposed to all known laws of wireless, were put forward as infallible cures and each in turn was derided by the next speaker.

Several very interesting facts resulted from the discussion, however, particularly the point that transmitting valves with a high plate voltage make excellent low-frequency amplifiers and also that the tuned anode (crystal rectification) circuit is remarkable for the number of low frequency valves, that can be put behind it before howling and distortion arises.

Hon. Secretary, Mr. L. L. Vizard, 12, Seymour Gardens, Ilford.

### The Hartlepools and District Wireless Society.

On Tuesday, April 25th, Mr. Wood, B.Sc., of Durham University, gave an exceedingly interesting lecture before the above Society. Mr. Patterson presided over a large number of members and friends.

The subject chosen by the lecturer was one of great interest at the present time, viz., "The Electron Theory"

Mr. Wood delivered his paper in quite an able and concise manner, considering the short time at his disposal, also the wide field over which this theory extends. By means of blackboard illustrations, he very simply explained facts which at first seemed very difficult to grasp. During the course of the evening, Mr. Wood referred to the excellent research work which had been accomplished by Sir E. Rutherford, Sir W. Crooks, Sir Oliver Lodge and Professor Soddy.

After the lecture a very interesting discussion arose, and the lecturer was kept busy answering questions, after which a hearty vote of thanks was proposed by Mr. G. Wenn, seconded by Mr. Marris.

The lecturer, in his reply, wished the Society every success. All present were then invited by the President to hear a few Morse signals on the receiving set which the Society had installed.

Hon. Secretary, Mr. R. L. Howey, 33, Grange Road, West Hartlepool.

### Portsmouth and District Wireless Association.

Secretary, R. G. H. Cole, 34, Bradford Road, Southsea.

Since our last report the Association has made rapid progress; there has been a large increase in membership and several interesting events have taken place. Reports having been received that a rival organisation, "The Portsmouth Radio Club," was being formed, negotiations were opened with its representatives, with the result that an amalgamation between this Association and the Portsmouth Radio Club took place on March 8th, to the satisfaction and mutual benefit of all concerned.

As the result of the increase of membership thus obtained it has been found possible to decrease the subscription.

An interesting and instructive series of progressive lectures on "Thermionic Valves" has been given by our popular member, Mr. J. H. C. Harrold, Associate I.R.E., while on the 19th April, Mr. Walters gave an interesting paper on "The Evolution of the Receiving Set" from the crystal stage to the two-valve combination in use at present.

The 26th April was a "red-letter day," being the occasion of a public demonstration and popular lecture on "Wireless Telegraphy and Telephony," by Mr. G. H. Watson, Associate I.R.E., which was held at the Portsmouth Municipal College by kind permission of the College authorities. The meeting was a great success and was greatly enjoyed by the members of the public present.

Forthcoming lectures will be found in the Calendar of Current Events.

### Walthamstow Amateur Radio Club.

Meetings are held every Wednesday at the Y.M.C.A., Church Hill, from 7.30 to 10 p.m.

At a General Meeting held on May 3rd the following officers were elected: Chairman, Mr. A. G. Allan; Treasurer, Mr. C. Fewings; Hon. Secretary, Mr. R. H. Cook; and a Sub-Committee of the following members: Messrs. Peirce, Butler and Smith.

The membership has greatly increased in the last few weeks, but there is still plenty of room and new members will be greatly welcomed. A programme and lectures are being arranged for the coming meetings and the requirements of every class of amateur will be considered. Field days for the summer months are being considered.

If any local amateurs are in difficulties with their sets they are invited to come to us, and we will do our best to help them. All communications to be addressed to the Hon. Secretary, at 49, Ulverston Road, Upper Walthamstow, or personally at the Y.M.C.A. on Wednesday evenings.

### Redhill and Reigate Y.M.C.A. Wireless Society.

A packed audience was able to realise at first hand, on Tuesday evening, some of the wonders of wireless telephony. The items of the concert were broadcasted from the Marconi wireless station at Writtle, Essex, and, in order that they could be "picked up," a set of receiving instruments was installed in the Y.M.C.A. Hall by Mr. H. A. Dossett, one of the company's experts. It was the first occasion of a public wireless concert being held in the borough, and the proceedings excited great interest, the hall not being large enough to accommodate all those who wished to be present.

Mr. H. G. White, one of the principal leaders in the Y.M.C.A. Wireless Society, presided, and in his introductory remarks said he wished to pay a tribute to the generous spirit of the Marconi Company in sending out these wireless concerts through the permission of the Postmaster-General.

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The concert was prefaced with an announcement of the items, which were sung by Mr. Lauritz Melchior, the great Danish tenor, and these could be heard comparatively clearly by those near the instrument, and presently the first strains of a pianoforte solo, played by Mdlle. Morwenna Felce (Melchior's accompanist), came to the ears of the audience. The other items followed in regular sequence, but Mr. Dossett was handicapped by the "cutting in" of ship and aeroplane messages, which prevented any coherent continuance of the items of the programme. The chief "offender" in "cutting in" was the station at Boulogne. The stations at Havre, the North Foreland and the Croydon Aerodrome were also heard, and a conversation between a land operator and an airman in flight was quite distinct.

At the conclusion of the lecture Mr. White expressed the thanks of all to the lecturer, and congratulated him on his efficient handling of the instruments. He appealed for support of the society. A large number of those present then visited an exhibition of the society's instruments, many of which were "home-made" with simple tools. One which created much interest was a simple receiving set which had received concerts such as the audience heard that night. A collection taken in aid of the society realised a satisfactory sum.

The Hon. Secretary (Mr. F. Howell, Y.M.C.A., 111, Station Road, Redhill) will be pleased to forward particulars of membership to any gentlemen interested in wireless telegraphy.

## The Leamington Spa, Warwick and District Radio Society.

At a meeting held on Tuesday, May 9th, with Mr. Sleath in the chair, it was unanimously decided to form a society as above. The following officers were elected: President, Captain Smith-Clarke; Vice-Presidents, Messrs. G. H. Champ and J. H. Evans; Secretary, Mr. F. A. Sleath; Treasurer, Mr. G. Kay; and Messrs. W. H. Reed, J. M. Richards, J. Clarke, L. J. Hills, F. Burton and Captain J. Hewitson. The entrance fee and annual subscription will be 2s. 6d. and 12s. respectively, payable in advance. A resolution was passed to approach the Education Authorities and the local Y.M.C.A. with reference to a club-room.

At about 8.30 the meeting was declared informal, and there was a short discussion on apparatus, etc., and it was also decided to commence general meetings with buzzer practice. In connection with the latter Captain Clarke kindly offered the loan of his Omnigraph for Morse teaching.

All enquiries should be addressed to the Hon. Secretary (Mr. F. A. Sleath), 31, Archery Road, Leamington Spa, and will be promptly attended to.

## Brighton Radio Society.

Hon. Secretary, Mr. D. E. Underwood, 68, Southdown Avenue, Brighton.

At the usual fortnightly meeting of the above Society, held at its headquarters in Buckingham Road, Brighton, members were again fortunate in listening to a valuable lecture delivered by Captain E. A. Hoghton, F.P.S.L., M.Inst.P., when the lecturer lucidly explained the various types of "Multi-Valve Amplifiers" in use, emphasising that the ideal of experimenters should be to secure signals from long distances which are distinct and readable rather than to obtain comparatively loud signals from adjacent stations, which are invariably accompanied by undesirable extraneous noises. In this connection the advantages of specially designed high-frequency amplifying circuits were outlined by the lecturer, and upon the conclusion of the lecture many queries were put by members of the Society and replied to by Captain Hoghton. Demonstrations then took place with one of the latest types of 6-valve amplifying receivers, and it was particularly noticed how quiet this instrument was in working, signals being received from various stations in a very clear and satisfactory manner.

A vote of thanks to the lecturer was proposed by Mr. W. E. Dingle, President of the Society. This was seconded by Mr. A. Blackburn, the proceedings then being terminated.

## Guildford and District Wireless Society.

The above Society held their usual weekly meeting at headquarters, 46, High Street, on Monday, May 1st. After the usual Morse practice, conducted by Major Harris, A.M.I.E.E., the members enjoyed an interesting "open discussion" evening. Questions regarding transformers and their action, and the screening of aerials from interfering bodies, such as overhead power wires, neighbouring railways and their electrical installations, etc., gave rise to some interesting remarks and discussion. The meeting closed about 9.30 p.m.

The Society is in its infancy, and the members are very pleased to know that Colonel the Earl of Onslow, O.B.E., D.L., J.P., has very kindly consented to become its first President. Like other societies, there is a keen desire to make for success, and therefore the kindness of the Earl of Onslow is fully appreciated.

There is still room for more members, and the Secretary will be pleased to hear from any who are interested; at the same time a hearty invitation is given to our Monday evening meetings, time 7 p.m.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

## Radio Experimental Association (Nottingham and District)

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

On Thursday, the 4th inst., at the Mechanic's Institute, Nottingham, the members of the above Association had the pleasure of listening to a very interesting paper read by Mr. Ley. The subject "Valve Amplification," is one by no means easily dealt with, and Mr. Ley's rendering of it succeeded in elucidating numerous points on which many of us were rather hazy. Numerous questions were asked and suitably replied to by Mr. Ley.

The second part of the evening was taken up by a demonstration of a Mark III short wave tuner, converted to use for long waves. Constructional details were very clearly explained by Mr. Shepherd, who had been instrumental in converting the tuner. Before the close of the meeting a hearty vote of thanks was given to those who provided the programme.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise.* (2) ***Four questions is the maximum which will be accepted at a time.*** (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents*

**"A.J.W." (Luton)** *asks* (1) *Why* FL *is only heard weakly on a three-valve set no stronger than on a single valve.* (2) *For wave-range of two pancake coils wound with No.* 30 *D.W.S.* (3) *Why Hague concerts are only received weakly and how to tune out jamming stations.* (4) *Whether tuner and amplifier should be mounted in one box.*

(1) This appears to be due to having too much wire on the reaction coil so that the set will not stop oscillating; also, possibly the H.F. transformer is not suitable for this wavelength. (2) You do not give the diameter of the coils so that we cannot make any calculation. (3) This is probably due to the same causes given in answer 1 above. No details of set are given so that we are unable to form a good opinion. (4) There should be no harmful effect provided the parts are well spaced.

**"CALPE" (Gibraltar)** *asks* (1) *Which is the better wire for a receiving aerial,* 7/28 *or* 3/18 *copper, or multi phosphor bronze wires.* (2) *If any detrimental effects may be expected from a generating station* 300 *yards away from the aerial.* (3) *If enamelled wire is suitable for receiving inductances.* (4) *Which is preferable, one valve H.F. with crystal rectifier or crystal rectifier and one stage of L.F. magnification.*

(1) For small aerials either of the stranded copper wires will be found satisfactory. (2) There will possibly be a little noise due to leakage earth currents, but this should not interfere much with reception. (3) Yes, for single layer coils, but not for closely wound slab coils. (4) The crystal and L.F. magnification will be the simpler to operate, but better results with weak signals will be given with the former arrangement. A suitable circuit is given on page 90, Fig. 1, April 15th issue.

**"A.E.T." (Nottingham)** *asks if three-valve diagram is correct.*

This circuit is O.K. It is hardly necessary to have a separate resistance for each filament. The crackling and buzzing is probably caused by a bad joint somewhere in the circuit, or perhaps one of the valves is defective.

**"W.L.B." (Bristol)** *refers to Pocket Set article in March 4th issue, and asks* (1) *Quantities of wire required.* (2) *If* PCGG *would be heard in Bristol.* (3) *How the wire on basket coils is fixed in place.*

(1) For A.T.I., 2 ozs. of No. 36; reaction coil, 2 ozs. No. 26. (2) The set gives best results with French soft valves. With ordinary hard valves it may just be audible in your district. It is quite possible that the reaction coil designed may not be quite sufficient for hard valves. (3) Before the pegs are removed the coil is dipped in almost liquid paraffin wax. When dry the pegs are removed and solidified wax holds the coil together. The ends of the coil should be tied with cotton to prevent unwinding.

**"H.L.E." (Montreal)** *refers to Fig.* 13, *page* 727, *of last volume, and asks* (1) *If an ordinary intervalve transformer may be used in place of one marked* 8,000 *and* 20,000 *ohms.* (2) *If set will be as sensitive over a wave-range of* 600-24,000 *metres as a set with "tickler regeneration."* (3) *If "Ora" valves will give as good results as the valves recommended.* (4) *If all valves may be lighted with one filament battery.*

(1) Yes. (2) The capacity reaction will not be suitable for the very long wavelengths. It will be advisable to insert a magnetic reaction coil in the second anode circuit in place of the 10,000 ohm resistance shown. (3) Yes, if the anode resistance of No. 1 valve is reduced to 50,000 ohms. (4) Yes. Do not short circuit the part of A.T.I. which is not in circuit as shown in this diagram.

**"A.L.M." (East Ham)** *asks* (1) *If formers described are correct for single valve set.* (2) *What station was transmitting telephony and music on March* 28*th and* 29*th.*

(1) The reaction coil (small former) appears to be on the small side. (2) This was probably the Eiffel Tower Station.

**"W.J.T." (Norbiton)** *asks* (1) *Gauges of sample wire.* (2) *Why short wave set will not oscillate unless grid condenser and leak are disconnected.*

(1) "A" No. 46 S.S.C.; "B" No. 43 S.S.C.; "C" No. 32 German silver, the resistance of which is approximately 3·5 ohms per yard. (2) The set is not described, so it is hard to say. Probably the reaction is not correct; it may be either too much or too little. On short wavelengths it is critical.

**"A.C." (Horbury)** *asks for sizes of samples of wire and for particulars of telephone and intervalve transformers, and for H.F. transformer for* 1,000 *metres to use wire similar to samples.*

No. 1 is No. 38 S.S.C.; No. 2, No. 38 enamelled; No. 3, No. 29 S.C.C. Wind telephone and L.F. intervalve transformer on soft iron cores ½" diameter and 3" long. The telephone transformer should have 10,000 turns of No. 38 S.S.C. for primary and 1,000 turns of No. 29 S.C.C. for secondary. The L.F. intervalve transformer should have 10,000 turns of No. 38 S.S.C. for each winding.



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For 1,000 metre H.F. transformer two windings each of No. 40 D.S.C. should be wound on a 1½" diameter former, 4" long.

**"REVAL" (Bournemouth)** *asks* (1) *For criticism of switching arrangement to change over from transformer coupling to resistance capacity coupling.* (2) *Why resistances are necessary in resistance capacity coupling.* (3) *Why, with transformer coupling, only one winding is tuned by a variable condenser.* (4) *Gauges of samples of wire enclosed.*

(1) The switching can be simplified as shown in diagram (Fig. 1). Unless care is taken to keep leads well separated to reduce capacity effects, it will be found that these switching arrangements introduce considerable loss of signal

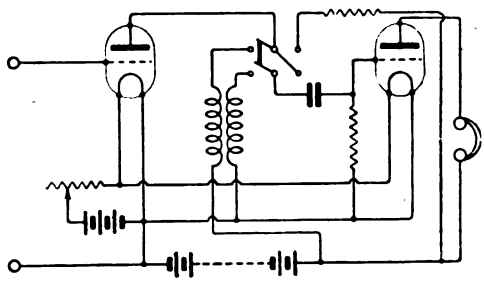

*Fig.* 1.

strength. (2) The resistance is necessary to provide the voltage change which operates the grid of the next valve. (3) These transformers are usually very tightly coupled so that tuning one circuit in effect tunes the other. If both circuits were tuned separately they would react on one another and reduce the efficiency of the whole combination. (4) Nos. 44 and 40 S.S.C. and No. 28 S.C.C. The No. 44 or No. 40 may be used for H.R. winding of the telephone transformer or for the H.F. transformer. The No. 28 may be used for L.R. winding of telephone transformer.

**"SIRIUS" (Brighton)** *asks how to add another valve with transformer coupling to his single valve set.*

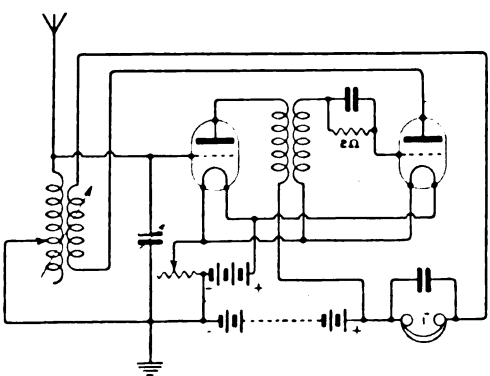


*Fig.* 2.

A diagram showing how to connect up is shown in diagram (Fig. 2).

**"M.T.G." (New Cross)** *asks* (1) *For criticism of single valve set.* (2) *If secondary condenser should be variable, and also its capacity.* (3) *Wave-range of set with* 200 *and* 500 *mhy. coils.* (4) *If interference from adjacent telegraph wires may be expected.*

(1) A small blocking condenser of 0·001 mfd. should be connected across telephones, also the grid condenser will require a leak of about 2 megohms. (2) This should be a 0·0005 mfd. variable condenser. (3) The maximum wavelength will be 300 metres. The coils are much too small for any useful work. Make a reaction circuit such as that described on page 90, April 15th issue, Fig. 3, using much larger coils than you have at present. (4) It is quite possible that there will be a certain amount of interference both from the wires and the electric railway.

**"R.G.L." (Ashtead)** *asks* (1) *for information regarding height of aerial required in a hollow garden at one end of which is a high tank.* (2) *If an amplifier may be connected to any ordinary receiver.* (3) *If possible to hear American H.P. stations on* 2,000 *metres.*

(1) 20 ft. is given as a good aerial height for a fairly open site. Your aerial should be higher than the tank, otherwise there will be considerable screening. Fix the mast on the top of the tank. (2) A low-frequency magnifier may be connected on to the telephone terminals of an existing receiver and it will magnify the signals. This is not the most efficient way of using valves. (3) We do not think there are any American H.P. stations working on such a wavelength. It is probable that you would not receive them on a simple receiver with L.F. magnification.

**"P.B." (Birmingham)** *asks for criticism of a two-valve set on which* **2MT** *telephony is weak.* Connect A.T.I. and A.T.C. in series not in parallel. You do not give sufficient particulars of your set to form an estimate as to whether the wave-range is suitable. Possibly the reactance tuning condenser on the first anode circuit does not tune to the 700 metres. Connect a 0·001 mfd. condenser across the high resistance winding of the telephone transformer.

**"RUSKIN" (Herne Hill)** *asks for details of a loose coupler for use as reaction to tune from* 180 *to* 400 *metres with a* 0·0005 *mfd. variable condenser in parallel.*

We presume that you intend to connect the condenser in parallel in the aerial circuit. For such short waves this is not recommended. Put it in series. An outer former of 3" diameter by 3" of winding of No. 22 D.C.C. should be used for the aerial circuit, preferably arranged with five tappings. Reaction inductance may be 2" in diameter by 1" of No. 28 D.C.C.

**"H.D." (Hornsey)** *has made the long range receiver described in the issues of February and March,* 1921, *is using a Mullard valve and* 2,000 *ohm telephones and home-made variable condenser; gives particulars of his aerial and wishes to know* (1) *Why he cannot receive signals.* (2) *If a zincite bornite detector could be used with advantage.* (3) *The capacity of his condenser.*

(1) Without examining the set it is impossible to suggest the fault, as it may be due to a variety

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of causes. We would recommend you to very carefully check your wiring and see that it is identical with that given. There is probably a break in your H.T. circuit, as you report no noise at all in the telephones. If everything seems in order, try reversing your reaction. (2) Little would be gained by adding a crystal detector to the set, at least, not until it functions correctly on the present arrangement. (3) As your moving plates are not triangular, we presume by "20 plates" you mean 20 fixed plates. Without knowing the thickness of the plates it is impossible to calculate the capacity, but presuming the zinc to be of the gauge usually obtained for household purposes, the capacity would probably be about 0·0004 mfd.

**"C.H.E." (Chelmsford)** *asks for a method of connecting a one-valve note magnifier to his valve receiving set with crystal rectifier.*

For circuit see Fig. 5, page 92, April 15th issue, and for the dimensions of an intervalve transformer, see issue of May 28th, 1921, page 152. A note magnifier, of course, considerably increases the strength of signals and your "V 24" valve should be quite suitable for use in the amplifying circuit.

**"G.B." (Walsall)** (1) *Submits circuit for criticism.* (2) *Asks whether "Oojah" coils and plug-in H.F. transformer would be suitable in the circuit.* (3) *How to arrange for reaction.* (4) *Whether the circuit is suitable for the reception of* PCGG.

The circuit is quite good, and providing the transformer is connected in the right direction and suitably wound, you should get good signals. (2) Quite suitable. (3) You should arrange reaction by connecting an additional coil in circuit with the plate of the first valve and coupling it to the closed circuit inductance which you show on the extreme left of your diagram. (4) Yes.

**"HIGH FREQUENCY" (Watford)** *asks* (1) *How to add an H.F. amplifier to the circuit shown in Fig* 1, *page* 30, *issue April* 1*st*, 1922. (2) *Whether it is necessary to alter the wiring of the panel.* (3) *The best method for using the set for the reception of telephony.* (4) *Number of turns of No.* 36 *D.S.C. wire for making intervalve oscillation transformer on a former of* 1" *diameter, and for wavelengths* 300 *to* 2,500 *metres.*

(1), (2) and (3) Arrange as in Fig. 3. (4) It is difficult to give the exact number of turns, and would recommend you to make a number of transformers and find by trial those most suitable for particular wavelengths. Helpful information will be found in Mr. Campbell Swinton's paper to the Wireless Society of London in the issue of June 25th, 1921, page 198. For 300 to 600 metres try 25 turns on the primary and secondary. For 600 to 800, 45 turns; for 800 to 1,200, 65 turns; and 1,200 to 1,800, 150 turns; and for higher ranges use capacity intervalve coupling. Instructions for interchanging resistance capacity and coils are given in the issue of April 29th, page 133.

**"P.M.P." (Birkdale).**—Your scheme for connecting one-stage H.F. amplifier is correct. Omit the condenser shown on the primary of the H.F. transformer unless you intend to make it variable and closely tune the circuit, in which case, the primary and secondary should be loose coupled. The finished circuit is a good one for the reception of telephony between 700 and 1,000 metres provided your transformer has the correct critical value. See reply to **"HIGH FREQUENCY" (Watford)** above.

**"P.F.G." (Smallheath)** *asks* (1) *For a three-valve receiver for telephony from* 300 *to* 5,000 *metres including* PCGG. (2) *The windings of coils for this set.* (3) *The most suitable telephones to use.* (4) *If a Sullivan H.F. transformer is satisfactory.*

(1) and (2) See issue of April 8th, 1922, page 37. The circuit given there is particularly suitable for your purpose. (3) You may use 200 ohm telephones or better, if high resistance, say 400, directly in the plate circuit of the last valve. If 120 ohm telephones are used you must employ a step-down transformer. (4) This type of transformer is particularly suitable, and no doubt the manufacturers who supply will show you how to connect it in the circuit that you have been referred to.

**"B.W." (Barnsley)** *asks* (1) *Whether it is better to use* 100 *feet single wire or* 140 *feet twin wire for aerial.* (2) *The meaning of* 2 MT. (3) *If he is liable to damage his telephones by not using a telephone transformer.*

Depends entirely upon circumstances. For short wave telephony reception, the twin wire would probably give better results, and, moreover, it could be tuned through a long range of wavelengths by a smaller variance of inductance. (2) The call letters of the telephony transmitting station of the Marconi Scientific Instrument Company at Writtle, Essex. (3) 4,000 ohm. telephones direct in the H.T. lead may be regarded as satisfactory in the hands of a cautious experimenter.

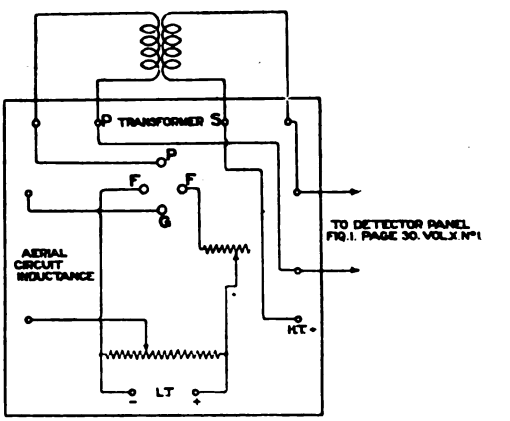


*Fig.* 3.

**"E.S." (Manchester)** *desires an explanation of the results he obtains with a second-hand pair of Sullivan telephones.*

Your telephones probably have a resistance of 120 ohms as you say they are wound with black enamelled covered wire, and most of the second-hand Sullivan telephones now on the market are of the low resistance type. This would account for your not getting signals with them on the 31A crystal receiver. We are of opinion that the telephones, being old, are probably out of adjust-



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ment and are no longer sufficiently sensitive for use on wireless circuits, though they are still sufficiently good on the liberal current available of the house telephone circuit. We recommend you to completely dismantle the telephones and thoroughly clean and overhaul them, and if necessary, fit new diaphragms and use them in conjunction with your Marconi step-down transformer.

**"R.L.C." (Wimbledon Park)** *asks* (1) *Where to purchase glass and silver tube for syphon recorder syphons.* (2) *If necessary to use reaction with single valve slab inductance telephony set.*

(1) These can probably be obtained from any manufacturer of chemists' specialities, such as Messrs. Baird & Tatlock, Hatton Garden, London, E.C., at small cost. (2) Yes. A single valve set is not of much use without a reaction coil.

**"A.H.B." (Portsmouth)** *asks* (1) *How to convert a Marconi Type* 31a *crystal receiver to a single valve set.* (2) *If external panel may be used.* (3) *Best part of aerial from which to lead-in.*

(1) and (2) For a valve as note magnifier connect the grid and negative side of filament to the 31a telephone terminals and the telephones and H.T. battery to plate of the valve. An external panel may be used for a H.F. magnification, and should be arranged as shown in the diagram (Fig. 4). It

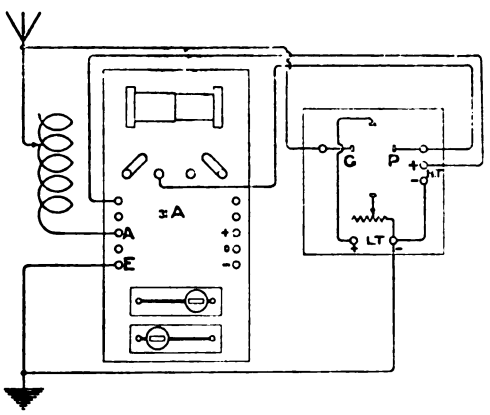


*Fig.* 4.

may be necessary to increase the winding on the crystal receiver sliding coil. The wave range of the set will be 200 to 2,800 metres. (3) This should be taken as near as possible to the receiving apparatus with a straight drop down from the aerial.

**"CUSTOS" (Bradfield)** *gets poor results from a reactance capacity coupling valve set, and asks* (1) *For particulars of windings.* (2) *If London telephony should be heard with two valves.* (3) *How many valves are required to get Hague,* **FL** *and other telephony on a loud-speaker.*

(1) There is a very good discussion on this subject in the issue of April 8th. This will give you the information you require. (2) Croydon telephony should be very strong. (3) At least five valves will be required, two of which should be note magnifier. There may be a certain amount of speech distortion.

**"S.J.D." (Manchester)** *asks* (1) *Wiring diagram for crystal set.* (2) *If aerial described is suitable.* (3) *If earth wire has to be insulated from wall of house.* (4) *If variometer may be used with crystal set.*

(1) *See* Fig. 3, page 60, April 8th issue. (2) This is a good aerial for such a set. (3) No. (4) A variometer, unless specially designed, only gives a small wavelength variation and is not to be recommended for your set.

**"G.R." (East Ham)** *refers to Fig.* 13, *page* 727, *and asks* (1) *If A.T.I.* 10″ × 5½″ *wound with No.* 28 *wire, will be suitable.* (2) *If interchangeable H.F. transformers may be used in place of resistance capacity.*

(1) The wire is too fine for an aerial circuit without magnetic reaction. Wind with No. 24 and use a loading coil if wavelength range is shorter than required. (2) They will probably be more efficient for short wavelengths than the arrangement shown.

**"A.S." (Anvers)** *asks how to clean and solder Litzendraht (enamelled) stranded wire.*

To satisfactorily solder this wire every strand must have the enamel cleaned off. Untwist the strands and hold them in a weak flame, such as a candle. The enamel will be almost burnt off and the wire can then be scraped clean with a knife or fine emery paper. For soldering use a flux composed of powdered resin in methylated spirits.

**"R.P." (Westcliff)** *asks* (1) *Why single valve set singals are better than those on a two-valve transformer coupled set.* (2) *If diagram is correct.* (3) *How to make two-valve set efficient.* (4) *The correct capacity across loose coupler secondary.*

(1) It seems obvious that the transformer cannot be suitable for the wavelength range of the set. Try a small condenser across the anode winding of the transformer. (2) Yes. (3) Connect grid leak to negative side of filament, and also use two similar valves. (4) 0·0005 mfd.

**"C.J.B." (Marton)** *asks* (1) *If crystal diagram is correct.* (2) *If steel wire may be used for an aerial.* (3 *If a number of trees will have screening effect.* (4) *Windings for telephone transformer for* 120 *ohm telephones.*

(1) As an elementary circuit this is correct, but it will not be very effective. Connect a small capacity condenser across inductance, as shown in Fig. 3, page 60, April 8th issue; also a 0·001 mfd. condenser across telephones. Owing to small inductance wavelength range will be very short. (2) No. (3) Screening will not be appreciable unless the trees are very close. (4) A suitable transformer will be 3 ounces of No. 44 and 6 ounces of No. 32, wound on a soft iron core ½″ diameter by 3″ long.

**"A.H.A.K." (Abingdon)** *has a T.F. receiver, and asks* (1) *How to add two additional resistance capacity coupled valves.* (2) *The values of resistance and condensers.* (3) *If it is correct that resistance amplifiers are not very efficient below* 1,000 *metres.*

(1) The T.F. receiver is small and compact, and there is not room for additional apparatus on panel. It is either necessary to do away with existing L.F. valves or have another panel. The diagram of an additional panel is shown (Fig. 5). (2) Anode resistances 50,000 ohms and condensers 0·0005 mfds. (3) Yes.

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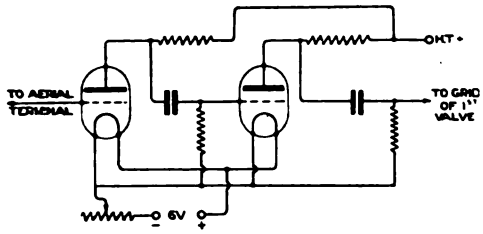


*Fig. 5.*

**"C.L." (Highbury)** *gives single valve diagram, and asks* (1) *If correct.* (2) *If an Ora valve will be suitable.* (3) *For a diagram showing how to add three other valves to set.* (4) *Wavelength of tuning coil* 10″ × 4″ *wound with No.* 28.

(1) Yes. (2) Yes. (3) The circuit given to **"B.D." (Leeds)** below, will be found very useful. (4) This will tune standard aerials to 5,000 metres with a 40-plate condenser across it.

**E.H.W." (Bingley)** *asks* (1) *If set described will receive* 400 *to* 3,000 *metres spark stations.* (2) *For improvements.*

(1) Maximum wavelength range at present is about 1,000 metres. The fixed 0·0015 mfd. condenser should be connected across telephones and windings altered as follows: primary 10″ × 6″ of No. 24, secondary 8″ × 5″ of No. 28. A small variable condenser should be connected across the secondary.

**"B.D." (Leeds)** *asks* (1) *For four-valve circuit diagram to fulfil certain conditions.* (2) *If Dutch Concert will be received.*

(1) The circuit shown in the diagram will be satisfactory. The circuit will be more selective if a coupled circuit is used as shown in Fig. 6. (2) Yes.

**"EXILE" (Madeira)** *asks* (1) *For suitable set on which to receive high-power European stations.* (2) *If such set would also be useful in Uruguay.* (3) *If there are any wireless dealers in his part of the world.*

(1) It would be possible to hear several H.P. European stations on a single valve set, but it would be advisable to make one with three or five valves. (2) On a five-valve set the European stations should still be audible, together with many of the American stations. (3) We do not know of any. It should be convenient to purchase from British manufacturers.

**"ELSIE" (Romford)** *asks for criticism of crystal set.* (2) *If it will receive C.W.* (3) *How to add a valve amplifier.*

(1) This circuit is incorrect. Rewire as Fig. 3, page 60, April 8th issue, omitting the potentiometer if desired. (2) C.W. cannot be received on crystal sets unless a means of breaking up the oscillations, such as a ticker, is used. This, however, is not advised. (3) A suitable circuit is shown in Fig. 1, page 90, April 15th issue.

**"J.G.H." (East Sheen)** *refers to page* 613, *December* 24*th issue, Fig.* 2, *and asks* (1) *If an A.T.I.* 11″ × 4½″ *of No.* 24 *may be used.* (2) *For*

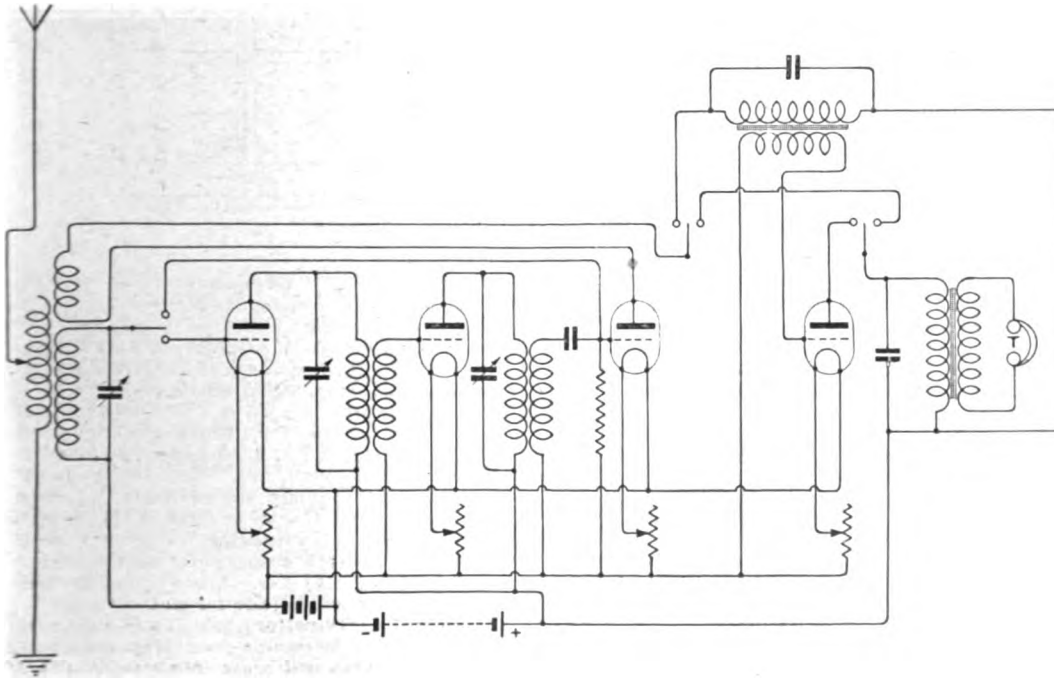

*Fig. 6.*

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*suitable reaction coil.* (3) *Capacity of condensers.* (4) *Range of set.*

(1) Yes. (2) This may be 6″ × 3½″ of No. 28. (3) Variable condenser 0·0005 mfd., telephone condenser 0·001 mfd. (4) 600 to 4,500 metres.

**"N.O." (Coulsdon)** *asks* (1) *Why no telephony other than Croydon is received on single valve set.* (2) *Wavelength range of set.*

(1) There is nothing wrong with this circuit except that a variable condenser should be connected across the A.T.I. instead of across the reaction coil. The reaction coil should be increased to 4½″ diameter wound with No. 30 wire. (2) Wavelength range will be 400 to 4,500 metres. It should be possible to receive other telephony on this set, but one or two more valves would be a great improvement.

**"J.S." (Blackburn)** *asks questions regarding screening of amplifiers.*

Absolute screening is difficult, but it is effective if the amplifier is placed in a box of sheet copper or zinc. The signals should not be appreciably weakened.

*former.* (2) *Which of the windings will be the primary.* (3) *If 6-volt 60 amp. accumulator is suitable for L.T. on a single valve set with French "R" valve.* (4) *If circuit he submits is suitable for reception of concerts.*

(1) Use half oz. No. 38 for secondary. Other dimensions satisfactory. Closed core would be a little more efficient. Walls of ebonite tube should not be more than 1/16″ thick. (2) Join secondary to telephones. (3) Yes. (4) The circuit is that shown in the issue of March 4th, page 749, and is quite suitable.

**"S.L." (Sutton)** *wishes to know* (1) *Whether a G.P.O. relay non-polarised type and rewound with No. 44 S.W.G. will be sufficiently sensitive for operation by a two-valve receiver.* (2) *What would be the best circuit.*

(1) No. A polarised type is almost essential, operated by at least four H.F. or three L.F. valves. See discussion before Wireless Society of London on Recording in the issue of October 29th, 1921, page 468, and in particular try the circuit given on page 474.

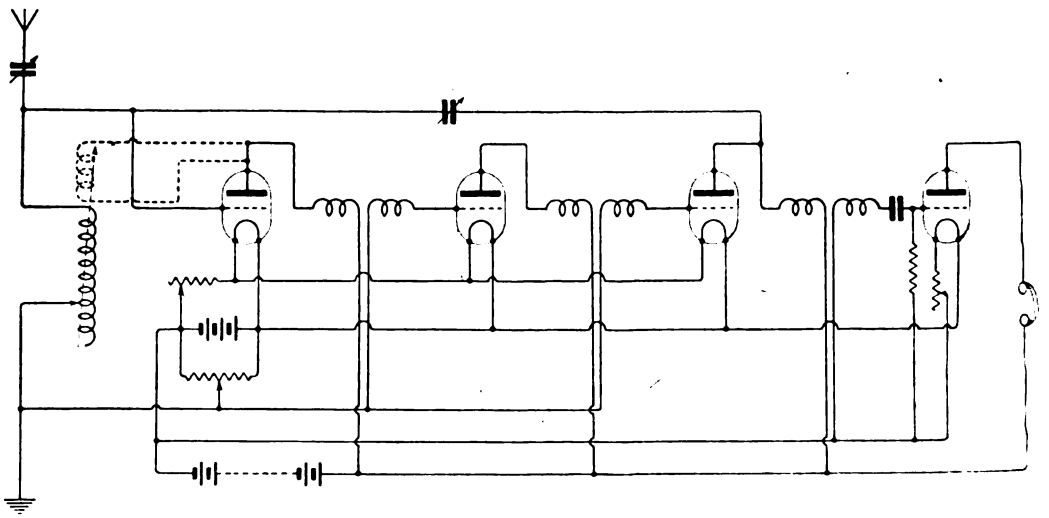

*Fig. 7.*

**"——" (West Ealing)** (1) *Gives a crystal circuit and asks for criticism.* (2) *Asks for the name of a book describing valve sets suitable for a beginner and whether American books are to be recommended.* (3) *Whether honeycomb coils can be used with a crystal set.* (4) *If the "school valve receiving set" will receive* PCGG.

(1) The crystal circuit is quite good, but do not use potentiometer and battery with a silicon detector. Maximum wavelength about 3,000 metres. (2) "The Amateur Valve Station," by Allan Douglas, Wireless Press, Ltd., price 1s. 6d. Many American publications are, of course, useful but are usually not on the lines of British practice and do not suit the conditions and regulations governing experimental wireless in this country. (3) Yes. (4) Yes, quite suitable.

**"F.I." (Erdington)** *asks* (1) *The suitability of certain dimensions for a step-down telephone trans-*

**"SEMI-AUTO" (Dewsbury)** *asks* (1) *For diagram of receiver employing three or four H.F. valves, size of inductances and condensers.* (2) *Whether four valves would be sufficient.* (3) *Whether he can use 220 v. D.C. mains in lieu of H.T. batteries* (4) *Whether his aerial will be satisfactory.*

(1) See diagram (Fig. 7) A.T.C. 0·0015 mfd. air dielectric. Inductance for 1,000 metres, the wavelength of PCGG, A.T.I. 4″ diameter, with 4″ of winding of No. 30 D.C.C. Reaction coils 3″ diameter × 2″ winding No. 34 S.S.C. (2) Yes. (3) Cannot be used directly or through chokes on a 4-valve receiver. Try making up a very small capacity high voltage accumulator and charge it from the mains. (4) Yes. Space wires at least 6 ft. apart. If possible raise fat end.

**"CALPE" (Gibraltar)** *asks* (1) *If a tramway generating station 300 yards from proposed site of his receiving station will cause interference.* (2) *If*

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*specimen of mica is suitable and its S.I.C.* (3) *Suitability of several types of wire.* (4) *Whether slab inductances are suitable for receiving purposes.*

(1) Very difficult to say. You do not mention whether the supply is single phase A.C. or direct. If the leads of the station do not pass the premises there may be little interference. (2) Yes, quite suitable. S.I.C. about 6. (3) Either of the wires you mention is quite suitable. For reception choose the lighter. (4) Slab inductances of the honeycomb type are thoroughly efficient but in assembling them keep them spaced about ¼" apart. See recent issue for replies to your earlier questions.

**"CONTACT" (Bradford)** *requires a 2-valve amplifier circuit transformer coupled with switch to cut out one valve, to be built as a separate unit to be coupled to 3-valve set.*

See diagram (Fig 8).

**"ANODE" (Harrow)** *requires assistance in the use of a French 6-valve amplifier, type* L1/1917.

It is regretted that we have no precise information regarding this set, neither have we had any experience in its manipulation. We cannot be certain of the wiring circuit as the set is of an early type. The usual pattern "R" valves are, as a rule, suitable for use with French amplifiers. Terminal L1. may be connected to one end of the reaction coil, the other end of which goes to the plate and L2 to H.T. plus. L1 and L2 should be bridged with a small condenser 0·001 mfd. Make sure that there is no connection between the L1 L2 windings and the H.T. terminals of the amplifier. To complete your set you need an A.T.I. and condenser and a reaction coil and an external rectifier-oscillator valve. The instrument is not designed for wireless work. The first three valves are probably H.F. though they have iron core transformers. The next is a detector valve, the grid control of which will probably require altering, and the other valves, note magnifiers.

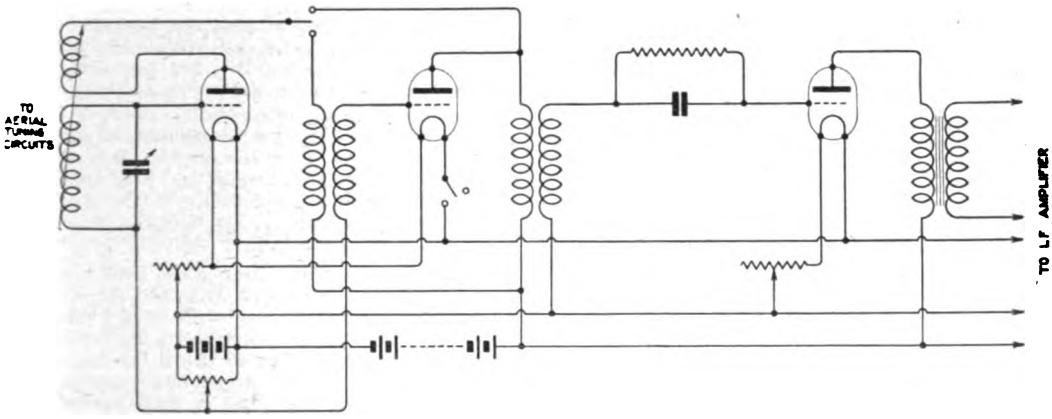


*Fig.* 8.

**"G.L.K." (Amsterdam).**—The variometer you show is quite good type but is intended for use as a coupled circuit, that is, for aerial and plate circuits of a reaction receiver. Assuming that the diameter is 4½", then about 220 turns of wire will tune your aerial to 2,000 metres with your aerial tuning condenser in parallel. For diagram and mode of operation of the new "2-grid valve," see issue of May 13th.

**"H.B." (Bradford)** *asks* (1) *Whether his circuit is suitable for the reception of telephony.* (2) *If the use of an additional valve is recommended.*

(1) Your circuit is correct except that you have omitted the leak across the grid condenser and the bridging condenser of capacity 0·002 mfd. across the telephones and H.T. battery. You give the dimensions of your coils but omit the number of turns, also gauges of wires, and you do not give the arrangement of your aerial. (2) An additional note magnifier would be a marked improvement. A letter addressed to the author of the article you mention, c/o *The Wireless World and Radio Review*, would be forwarded.

**"F.G. St. G." (Southwold)** *gives a list of wireless materials he has to hand and which comprises parts for a single valve receiver complete and asks for circuit and general advice for setting up a receiving station.*

It is impossible to give all the information you require in these columns and we would advise you to obtain "The Amateur Valve Station," by Allan Douglas, Wireless Press Ltd., price 1s. 6d.

**"M.G.M." (Churchtown)** *asks* (1) *If the coils he has are suitable for making up a valve receiving set.* (2) *The size of the condensers required.* (3) *Whether telephone wires crossing his aerial at right angles and 10 ft. above will affect his reception.* (4) *If a single valve receiver would receive Chelmsford.*

(1) and (2) Yes, quite suitable. Connect up as in circuit, Fig. 2, page 140, April 29th issue, where other helpful details will be found. (3) It is usually a disadvantage to have your aerial crossed by telephone wire, although perhaps they will not have any very serious effect. If you get overhearing you should report the matter to the Post Office authorities. (4) It is doubtful if a beginner would be successful in receiving **2MT** on a single valve set in Lancashire.

**"H.J.P." (Bristol)** *asks* (1) *If his wiring diagram is correct.* (2) *Why his slab coils fail to function.*

Your wiring diagram is quite correct to that given on page 47. This circuit has since been amended, and

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a correction is given in the issue of May 6th, page 179. (2) It is difficult to suggest what is wrong with your coils. Make sure that they are thoroughly dried out. When treating coils with shellac varnish it sometimes happens that the outside becomes dry whilst the interior retains a small quantity of moisture. Varnished coils should always be well baked.

**"A.B.K." (Pretoria).**—(1) Use circuit given on page 140, April 29th issue. You will need to obtain a grid leak. (2) It is impossible to say range of wavelengths without particulars of aerial and dimensions and windings of coils. (3) Make your set to the diagram given on page 140, but use your own inductances. A double pole, two-position switch might be added for connecting the A.T.C. in series or parallel with the A.T.I.

**"F.C." (Romford).**—(1) The voltage for the operation of most "R" valves is 4 to 6 volt filament and 30 to 60 volt plate. A tuner is required with the panel and should be a loose coupled one in order that one inductance may serve as A.T.I. and one as reaction. (2) We are not acquainted with stations having the call signs you mention. (3) We recommend you to use two or more valves. (4) 1430 B.S.T.

**"C.W.T." (Blackheath)** *asks* (1) *If crystal circuit he submits is correct.* (2) *How he can extend its range to* 20,000 *metres.* (3) *How to add a valve amplifier.* (4) *Whether it is better to use a valve functioning as detector amplifier or to amplify from his crystal.*

(1) Your circuit is quite correct. (2) There would be little use in extending the range of your set to 20,000 metres as it would only detect damped signals and there are no such signals on wavelengths exceeding about 5,000 metres. To increase the wavelength range add turns of wire in the aerial circuit and connect a variable air dielectric condenser between aerial and earth, that is, in parallel with your inductance. (3) and (4) Use a valve as detector amplifier and use the circuit shown on page 140, April 29th issue. You may use your crystal still as a detector if you like after H.F. amplification and reaction by using the circuit shown on page 124, April 22nd issue.

**"J.T.Q." (Edgbaston)** *asks* (1) *For criticism of four-valve diagram and values of condensers.* (2) *If* PCGG *will be heard.* (3) *If any advantage would be gained by using an ordinary aperiodic reaction coil, in place of existing tuned anode circuit.* (4) *If two more H.F. valves are added in his circuit, where should reaction coil be connected.*

(1) For short wavelengths the A.T.I. and A.T.C. should be connected in series, otherwise circuit is O.K. A 0·01 mfd. condenser across H.T. might be an advantage, and also a 0·001 mfd. condenser across the rectifier anode winding of inter-valve transformer. (2) Yes, if the windings of the aerial and secondary circuits are such as will tune to its wavelength. (3) For short wave work the tuned anode circuit will be very advantageous and the set will give as good results as one with two more resistance coupled valves. We do not advise making the change. (4) If two more H.F. valves are added for long wave work it will be advisable to substitute an ordinary aperiodic reaction coil in place of the tuned anode circuit.

**"W.P.G." (Gloucester)** *has a single-valve set without reaction, and asks* (1) *If grid condenser and leak are necessary.* (2) *If galvanised roof 8' below lead-in will affect signals.* (3) *For criticism of circuit.* (4) *If jolting the table causes a ringing sound in telephones due to filament vibrating and varying the electron flow.*

(1) A grid condenser and leak would be a decided advantage. The condenser about 0·0003 mfd. may be made up of two pieces of tin 2" × ½", separated by a 3 mil. mica sheet. (2) Not to any appreciable extent. (3) The set is not of much use without a reaction coil. A suitable one would be 12" of No. 28 on a 4" diameter former, which should be connected between the anode of the valve and the positive H.T. This should slide in and out of the A.T.I. Connect a 0·001 mfd. condenser across the telephones. The variable condenser is probably sufficient for fine tuning. Your maximum wavelength will be about 6,000 metres. (4) Yes.

**"J.W." (Oldham)** *asks* (1) *For diagram of receiver with one H.F. valve for crystal rectification.* (2) *A suitable crystal to use.* (3) *Would such set be as efficient as one with a valve rectifier.*

(1) A suitable diagram is given in Fig. 1, page 90, April 15th issue. (2) A carborundum crystal may be used with the potentiometer. A zincite-bornite, or Galena, steelpoint combination may be used without potentiometer, the latter two detectors may be made more sensitive, but will not be so stable as the carborundum. (3) Yes. We cannot tell you the type of set used at **FPE**, but are certain signalling is not done by making and breaking of the aerial circuit.

**"A.F.H." (Bishop's Waltham).**—Owing to the ½" spacing of the turns of your frame aerial its natural wavelength will be low, probably about 200 metres.

**"A.S.C." (Mitcham)** *asks questions regarding a crystal set.*

With the present inductances the results will be very poor, owing to the fine wire used for winding. The former should be made about 5" diameter and wound with No. 24 wire. A tuning condenser, connected as Fig. 3, page 60, April 8th issue, will be found an advantage. Carborundum crystal may be used if desired. It would be more stable than the silicon. Mounting the apparatus on wood does not matter if the wood is thoroughly dry.

**"L.J.H." (London, N.1).**—We know of no other published information regarding the Beverage aerial other than that given in the recent article in our columns, nor do we know of any publication dealing with typewriter reception. It is possible that some mention of the typewriter for telegraph recording is made in Herbert's "Telegraphy."

## SHARE MARKET REPORT

**Prices as we go to press on May 19th, are :—**

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 16 | 4 |
| ,, Preference .. .. | 2 | 11 | 10 |
| ,, Inter. Marine .. .. | 1 | 14 | 6 |
| ,, Canadian .. .. | | 13 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. .. | 1 | 6 | 0 |
| Preference .. .. .. .. | | 16 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 10. JUNE 3RD, 1922. WEEKLY

## On Heterodynes

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

(*Continued from p. 255.*)

IT was pointed out in the last instalment of this article, that the action of the two condensers in series across the ends of the tuning coil could be looked upon as analogous to that of a potentiometer—the connection of the valve filament to the common mid point of the condensers providing a means of dividing the total potential difference across the oscillation circuit into two parts, one of which is joined across the anode circuit, while the other is applied to the grid. This being the case one might enquire whether it would not be possible to apply such an electrostatic or condenser potentiometer to the ordinary oscillation circuit of Fig. 13,

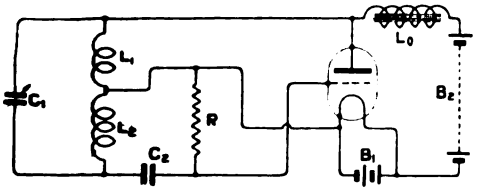


*Fig.* 13. (*Repeated from last issue.*) *Heterodyne Oscillator with Magnetic Coupling.*

(which is reprinted here for convenience in reference) so as to provide a means of electrically obtaining the tapping point shown near the centre of the coil L in that diagram, without actually making a tapping on to the coil itself. The use of an actual tapping on the coil implies that if it is desired to change the coils by means of a plug socket as in the previously described arrangements, provision must be made for the fitting of a special three-pin or four-pin socket on the instrument, and for the mounting of all the coils that are to be so used on special three-pin or four-pin plugs. By making the tapping electrostatically in the manner to be described below this disadvantage is eliminated and the use of a single standard two-pin plug socket retained.

The circuit arrangement is shown in Fig. 19, in which L and C are the main tuning coil and condenser respectively, the ends of which are joined to the anode and grid of the valve in a similar manner to that already described, a stopping condenser $C_3$ being inserted in the grid lead, with a leak resistance R between the grid and the filament. Across the oscillation circuit LC, is joined the "electrostatic potentiometer," formed by the two condensers $C_1$ and $C_2$ in series, and the connection to the filament of the valve is made to their centre point in a similar manner to that described in connection with the instrument using the double variable condenser (Figs. 14 and 16).

The wavelength of the oscillation circuit can thus be loaded up by means of the single variable condenser C—which may, if necessary, as in the case of the magnetically coupled instrument, be made up of a variable air condenser in conjunction with one or more fixed condensers connected in parallel with it by means of the range switch. The capacity of the two condensers $C_1$ and $C_2$ in series will, however, be additive to the capacity of the variable tuning condenser C, and needs to be taken into account when predetermining the wavelength range of the circuit.

It is found in practice that the ratio of the capacities of the two condensers, $C_1$ and $C_2$, requires to be changed somewhat as the wavelength is altered in order to obtain the most stable oscillations. This effect is doubtless due to the fact that one of the condensers ($C_1$) is shunted, not only by the valve itself, but also by the telephones T and battery $B_2$, whereas the other ($C_2$) is shunted by

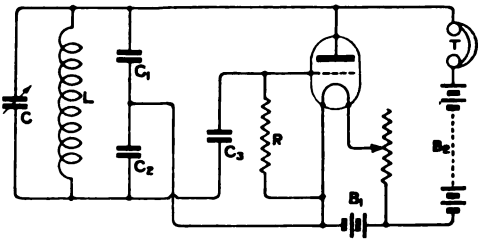


*Fig.* 19.

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the condenser $C_3$ in series with the resistance R, which is in shunt to the grid-filament path in the valve. The shunting impedance of these two paths will depend upon the wavelength of the oscillations, so that the relative voltages tapped off by the ratio condensers $C_1$ $C_2$ and applied to the anode and grid of the valve will also vary. Altering the ratio of their capacities as the wavelength is increased (by means of the condenser C) enables this variation of effective ratio to be overcome and stable oscillations to be produced over the whole tuning range of wavelengths.

Using a set of Burndept tuning coils for the coil L (Fig. 19), and a variable air condenser of maximum value = 0·0005 microfarad. the condenser $C_1$ can be fixed at about 0·00040 $\mu$F, and $C_2$ made about 0·00025 $\mu$F for coils Nos. 50 to 200, and increased to 0·0005 $\mu$F for coils 300 to 1,000.

The tuning range of the set under these conditions is about 400 to 17,000 metres.

The condenser $C_3$ shown in the grid circuit of the valve in Fig. 19 is necessary merely to insulate the grid from the high positive voltage that would otherwise be impressed upon it from the H.T. battery. Provided, therefore, that its insulation resistance is high, its capacity value is not very important as long as it is kept large enough not to oppose any serious impedance to the passage of the high frequency pulses from the oscillation circuit. Since the frequency of the oscillations set up by the valve used in this instrument can be varied over a wide range, it is desirable to employ a fairly large capacity, such as 0·01 $\mu$F for this condenser. The leak resistance R has its usual function —that of maintaining the proper grid potential relative to the filament, but at the same time it has some effect upon the strength and stability of the oscillations. While the ordinary values of grid leak resistance—of the order of 2 megohms—can quite well be employed here, somewhat improved results are obtainable with a lower resistance value, such as 60,000 ohms, as thereby the changes of frequency of the oscillations due to changes in the filament current or H.T. voltage are much reduced. For example, with one particular V.24 valve, and associated circuits built up in the manner here outlined, and using the above values of resistance and capacities, neither a change in the filament battery voltage of nearly 1 volt, nor a 25 per cent. change of H.T. battery voltage produced much effect upon the frequency of the oscillations, as indicated by the beat note obtained with another valve which was maintaining steady oscillations. Even at the highest frequencies, *i.e.*, at the shortest wavelengths to which the heterodyne would tune, these large changes in the operating conditions only altered the beat note by a very few cycles, while ordinary battery variations that are likely to be experienced produced no appreciable effect. The position of this leak resistance R, *i.e.*, joined directly between grid and filament should be specially noted, as in this case it must *not* be connected across the grid condenser $C_3$ in the usual way.

The general arrangement of an instrument built upon these lines is shown in Fig. 20, which gives the leading dimensions and location of the parts. For the sake of uniformity the outside dimensions of the containing box have been made the same as those of the instruments that have already been described in the earlier parts of this articles, viz., 9¾ ins. by 6 ins. by 4¾ ins. high when completed. The ebonite top, details of which are shown in Fig. 20, should be ¼ in. thick. Details of the valve-holder springs remain the same as those already described, Figs. 4 to 7. The complete valve holder also is mounted in the same position, with one of the filament springs clamped under the LT terminal. The position of the coil holder is shown in Fig. 20, one only being required. The variable condenser

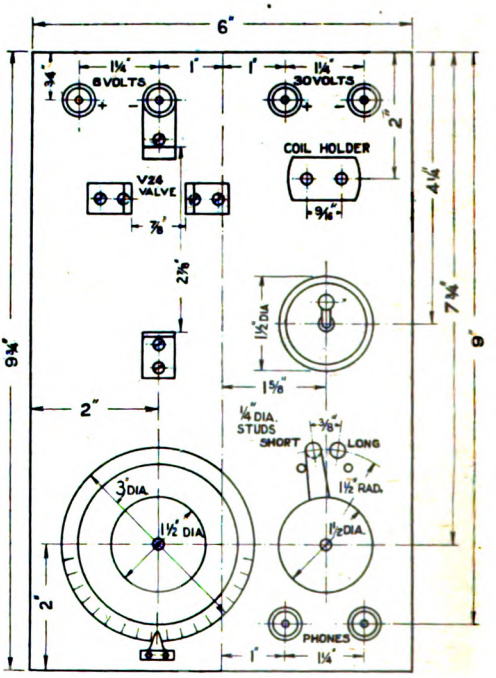


*Fig.* 20.

is also of the same type as used in instruments (1) and (2) described above, except that its maximum capacity need not exceed 0·0005 $\mu$F.

The range switch in this instrument is fitted with two contacts only, as it does not here perform the same function as it does in the instruments already described. It is used here solely to add additional capacity in parallel with one of the "e.s. potentiometer" condensers for the longer wavelengths for the reason that has already been described. It does not serve as a "range switch" in the sense in which that term has been used in the earlier parts of this article, since all the tuning is here done with the single variable condenser. The switch itself can be built up on the lines shown in Fig. 9 (page 195), and its detailed connections are given in Fig. 21, which also shows the mode of interconnecting the other parts of the set. The condensers forming the electrostatic potentiometer can be mounted in any convenient position on the under side of the top of the instrument. They may conveniently be fixed near to the "range" switch, or between that switch and the coil plug socket, since they have to be connected to both those parts. The resistance in the filament circuit of the valve, shown in the circuit

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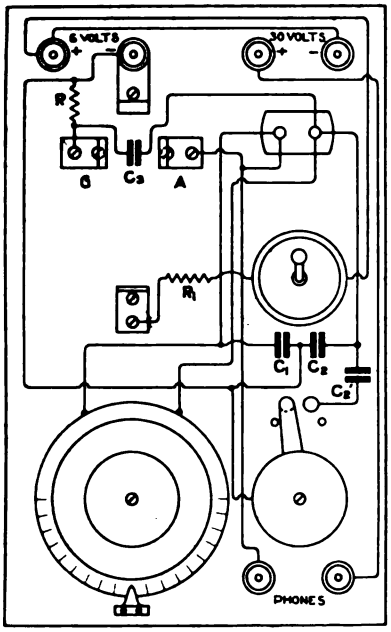


*Fig.* 21.

diagram, Fig. 21, may be made on the lines already described in an earlier part of this article, and may be given about the same resistance value.

Using a V-24 valve with the capacity values, etc., here described, Table VI shows approximate wavelength ranges obtainable with the coils, of which the numbers are given in column 1. The figures given are for Burndept coils. Column 2 indicates whether the "range switch" should be on stud 1 or on stud 2, in order to secure the proper working of the instrument and to give the wavelength values tabulated.

Other intermediate coils can, of course, be employed if desired in order to get any particular wavelength range nearer to the centre of the condenser scale. For this purpose it is evidently not essential to retain the use of standard plug-in coils, since any coil can be connected into the circuit by providing it with the appropriate plug connection. To facilitate the choice of extra coils for this purpose, the inductances of the coils listed in Table are also given. The necessary inductance value to be given to a coil for use in any particular part of the wavelength range of the instrument can thus be obtained approximately by inspection with little trouble.

TABLE VI.

| Coil No. | Position of "Range-Switch." | Approximate Wavelength Range (metres). | Coil Inductance $\mu$H. |
|---|---|---|---|
| 50 | 1 | 380—600 | 135 |
| 75 | 1 | 550—910 | 305 |
| 100 | 1 | 740—1,160 | 535 |
| 150 | 1 | 1,020—1,650 | 1,120 |
| 200 | 1 | 1,450—2,460 | 2,240 |
| 300 | 2 | 2,420—3,650 | 4,600 |
| 400 | 2 | 3,440—5,200 | 9,600 |
| 500 | 2 | 5,000—7,850 | 20,500 |
| 750 | 2 | 7,800—11,800 | 48,900 |
| 10,000 | 2 | 11,300—17,000 | 101,500 |

A heterodyne of this type using only one coil for each wavelength range is capable of retaining a much more rigid calibration that the types described in the earlier parts of this article in which two coils are used (one serving as reaction) since it is not easy to obtain rigidity of these coils, and absolute constancy of their relative position when in use, and still to retain ease of replacement. Greater rigidity can, of course, be obtained when the tuning and reaction coils for each range are built up rigidly together, and provided with four connecting pins or contacts, but such an arrangement entails the use of specially constructed coils, whereas with the instrument just described any coil is suitable provided that it is rigid in itself—*i.e.*, that its tunes are rigidly mounted so as to eliminate individual movement among themselves.

*(To be continued.)*

# An American Short Wave Receiver

By FREDERICK J. RUMFORD, A.M.Am.I.E.E.

AMATEURS have long needed a cheap but efficient short wave receiver. The set described is easily made up and requires but very few parts, and is so assembled that it is easily accessible at all times for the changing of circuits, if so desired. It is designed along the lines of the famous "Paragon" short wave regenerative receiver, and will give results unexpectedly good. While it has not been put to any extensive test, it has worked on 100 to 400 metres with very good results, and I feel sure that the builder could get still better results by further experimentation.

I will now describe the parts needed for making the set. Two 3-inch dials, engraved as shown on the drawing, and one 2-inch dial, also engraved, will be required. These dials must have knobs attached to them. Eight brass terminals are also needed, and one complete variable switch with five contact studs, their necessary nuts and washers. The switch lever should swing within a radius of 1 inch. This switch is for the purpose of tapping the primary of the loose coupler. One of the contacts on this switch is left idle.

Fig. 1 shows the front of the panel, with the necessary components mounted in place, and Fig. 2 represents the rear view, showing the variometers and loose coupler and the method of mounting them.

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Fig. 3 shows a side view of the loose coupler, with the method of mounting it 3 inches from the back of the panel, as well as the method of placing the bracket for the coil former. Fig. 4 shows the method of wiring, including internal and external circuits.

The panel may be of Bakelite, or ebonite. It should be 12″ long, 6″ wide and from ¼″ to ⅜″ thick. All the measuring and drilling for the necessary holes should be done first, after which the panel should be sand-papered. For the shafts on the variometers there should be ¼″ holes drilled. The binding-posts and switch contacts should have $\frac{11}{64}$″ holes and the switch lever a ⅜″ hole. After this is done the panel is ready to be engraved. The different symbols appearing on the front of the panel should be engraved upon it with some sharp-pointed tool.

For the coils six formers must be procured, two of 4″ in outside diameter by 2″ long and with a thickness of ⅛″; one 3″ in outside diameter,

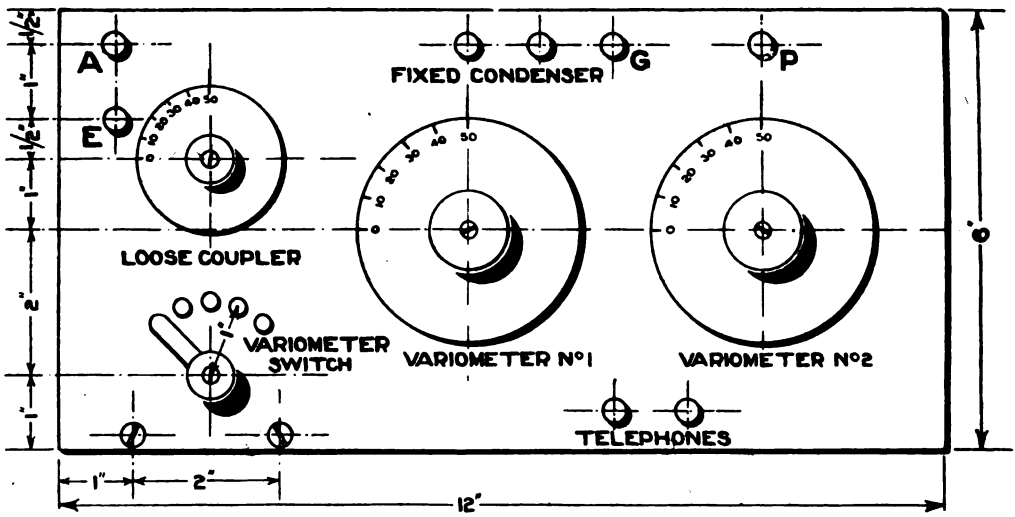


*Fig. 1.*

2″ long and ⅛″ thick; two 2¾″ in outside diameter, 2″ long and ⅛″ thick; one 4″ outside diameter, 3½″ long and ¼″ thick. All formers that are 4″ in outside diameter are for the primaries of the variometers, and the formers smaller in outside diameter are for the secondaries. The two primaries that are 2″ long must be drilled in the centre with holes to allow a loose fit of a ¼″ shaft. This shaft is the means by which the secondary is revolved within the primary, and the hole to be drilled in the secondary formers should be small enough to allow for a snug fit on the same shaft. After this has been done the four coil formers should be given a couple of coats of some good insulating varnish.

In this instance the writer has used No. 24 D.C.C. wire. On the primary former of variometer No. 1 the winding should start ⅛″ from the end and continue for ⅝″. A space of ½″ is then skipped, and the winding continued to ¼″ from the end. It is advisable to fit small screws on the ends of each of these coils, with suitable nuts and washers to attach the wire on the starting and finishing of the winding of these coils. This also provides means of joining the primary and the secondary in series. There will be about 42 turns in all on the primaries of variometers Nos. 1 and 2.

As the reader will note, on Fig. 2 the coils are all wound in two sections. The primary for variometer No. 2 is wound just as the primary on variometer No. 1. When both primaries are wound they should be given a good coat of shellac and allowed to dry.

We will now pass to the making of the secondaries for variometers Nos. 1 and 2. These coil formers are 2¾″ in outside diameter and 2″ long. The winding starts ⅛″ and continues for ¾″, leaving a ¼″ space. It again continues over ¾″, leaving ⅛″ at the end. These coils are fastened at both ends in the same way as the primaries, and should be shellaced as before.

We will now start on the loose couplers. The primary is 4″ outside diameter, 3½″ long and ⅛″ thick. The primary should have a projection on it, as shown in Fig. 2. The purpose of this projection is to provide a means of fastening the shaft. This former should be shellaced as before. After it has dried, the winding will start on the projection, and by attaching the wire to a screw, as mentioned above. It should be wound 2″ down with No. 24 D.C.C. wire—in fact, all the coils are wound with this size wire. From this coil four taps are taken off. All the coils, by the way, must be wound in the same direction. As the 2 inches of winding will equal 66 turns of wire, the taps should be taken off on the 16th, 33rd, 49th and the 66th turn. A good way to take them off is to scrape the insulation off the wire for a short distance and solder short pieces of No. 24 bare copper wire upon the scraped section of wire, these being in turn connected to the different contacts on the switch. We are now ready to make up the secondary coil for the loose coupler. This former is 3″ in outside diameter

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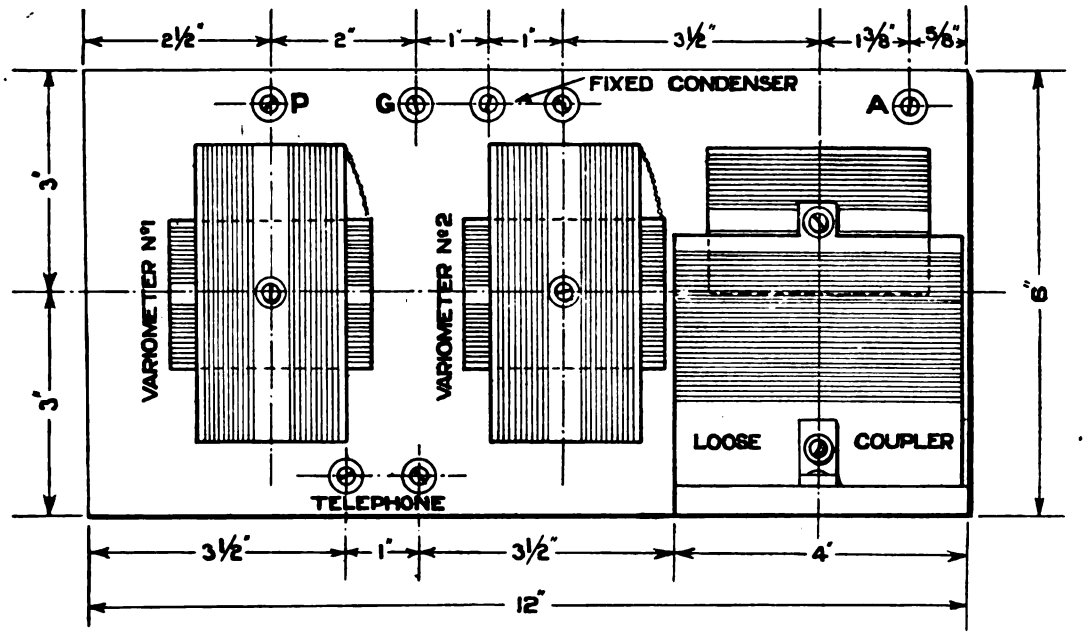


*Fig. 2.*

and 2" long, with a wall ⅛" thick. It should have a hole drilled in the centre of it to allow a ¼" shaft to fit snugly. This shaft serves to revolve the secondary coil within the primary. The primary of the loose coupler should also be drilled for the shaft. The beginning of this coil will be fastened as was done in the case of the other coils, and the winding will continue for ¾", will skip a space of ¼" and continue again for ¾" more, the end being secured for a screw. The secondary is now ready for its coat of shellac.

The primaries of variometers Nos. 1 and 2 will have 42 turns upon each (21 turns per section), which will total about 45′ of wire to each primary. The two secondaries of variometers Nos. 1 and 2 will have 50 turns each, with 25 turns to a section. Each coil would take about 36′ of wire. The loose coupler primary has 66 turns of wire—equal to about 71′ of wire. The loose-coupler secondary is 3" in outside diameter and has 50 turns of wire (25 turns to a section), which would equal about 40′, with a grand total of 273′ of wire in all, or about ¼ to ½-lb. of the size given.

We are now ready to assemble the outfit. We will mount the primaries of variometers Nos. 1 and 2 by four little wood screws (two to a coil), which will screw in through the coil former into the back of the panel, so that the shaft hole on the coil former will come in line with the hole in the panel. After this we will get the necessary shafts, which should be threaded for their whole length. Each of these shafts should be 5" long and ¼" in diameter. One end of these shafts should be screwed up into the knob of the dial and pinned so that it won't work loose. It is then pushed through the panel from the front, through the primary coil, and nuts run on it so that there will be a nut on the front and back of the secondary at each end, and on the inside and outside of the primary, which when screwed up tight against the formers will hold them securely. The above operation will be executed on both variometer assemblies respectively, No. 1 and No. 2. In joining the primary and secondaries in series, connection should be made by taking pieces of flexible lamp cord of sufficient length and connecting the ends to the screws that have already been provided.

We will now pass on to the assembling of the loose coupler. We require a base for this 8" long, 4" wide and ⅜" thick, which in turn is secured to the back of the panel by two wood screws, which go through the panel from the front. This base will support the primary of the loose coupler. The primary is mounted upon the base and held there by four little brackets, two of angle form and the other two straight. These brackets can be of either copper, brass or iron. The builder must bear in mind that between the back of the panel and the front of the primary coil former there must be just 3" of space. This is absolutely essential, or otherwise, when the secondary or variometer No. 1 is rotated, it will rub against or strike the primary of the loose coupler. After the primary has

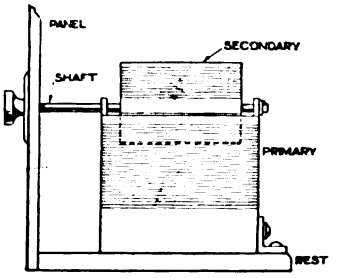


*Fig. 3.*

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been fixed the secondary of the loose coupler is mounted in the same manner as the secondaries of the two variometers. The wiring for the back of this panel is done with No. 18 stiff bare copper wire, which will be bent into the different shapes desired. Fig. 3 shows the true method of mounting the primary of the loose coupler. The taps on the primary are joined to their respective contacts on

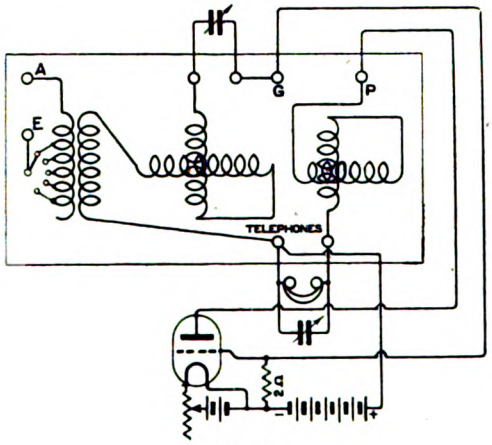



*Fig. 4.*

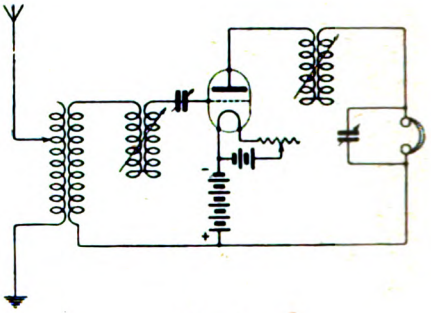


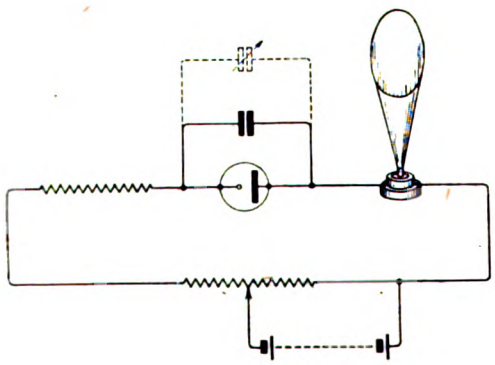
*Fig. 5.*

the panel. Fig. 4 shows the method of wiring, and Fig. 5 shows the simplifier circuit diagram. This set can be mounted in cabinet form or upon a pair of brackets.

# The Production of Electrical Impulses by the Neon Tube

AT a recent meeting of the Physical Society, Mr. S. O. Pearson, B.Sc., gave an interesting demonstration of the production of electrical impulses by means of neon gas-filled lamps.

He first drew attention to the small current controlling resistance which is to be found in the socket of the neon lamp of the type recently introduced for low candle power lighting. It was shown that a very critical voltage was required to set up the glow, and how, when once established, it could be maintained on a lower voltage. Curves were given to show the potentials at which the glow was established, and at which it disappeared. From this it is interesting to consider the effect of shunting the tube with a condenser, as shown in the accompanying circuit diagram. On applying the potential to the lamp and condenser an interval will elapse during which the voltage across the condenser will build up as it acquires a charge. On reaching the critical voltage the lamp glows and the energy required to maintain the glow will be drawn partly from the charged and partly from the charging supply depending upon the resistance in circuit. When the condenser voltage has dropped below that required to continue the glow, the resistance across the lamp electrode is restored and a re-charging of the condenser immediately commences. This cycle gives rise to a flashing of the lamp and with suitable values of resistance and capacity, flashing at intervals as long as one minute can be obtained. A reduction of the capacity of the shunt condenser or an increase in the value of the series resistance increases the rapidity of the impulses which can then be detected by telephone receivers connected either in the lamp and condenser circuit or in the battery leads.



The demonstrator gave much data on the determination of the frequency and equations, showing the relationship between the governing factors. Apart from the many other applications of the neon gas-filled lamp, the property opens up a very extensive field for research and there is little doubt that before long it will find a place in wireless equipment.

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# Static Interference as a Function of Wavelength*

By H. T. FRIIS and L. J. SIVIAN.

## INTRODUCTORY.

The purpose of this note is to comment upon a recent theoretical investigation by M. Abraham† of the relative immunity from atmospheric disturbances in closed loop and open aerial forms of receiving antenna, and upon a subsequent paper by L. B. Turner‡, on the signal-static ratio as a function of wavelength. The calculations in the latter paper are based on Abraham's results, which are believed to be in error due to Abraham's incomplete circuit equation for the loop aerial, and due to his choice of initial conditions for both the loop and capacity aerial equations.

In the present state of our knowledge regarding the nature of atmospheric disturbances any quantitative discussion of their effects in receiving aerials is necessarily largely speculative. The importance of the subject, however, is evident to anyone acquainted with the operation of long-distance stations at the present day, and warrants closer examination of the assumptions underlying its discussions.

As the receiving aerial is tuned to longer and longer wavelengths the static disturbances steadily increase with no indication of a maximum corresponding to a definite frequency. The general trend of the phenomenon may be judged from L. W. Austin's§ static-wavelength curves. It appears plausible to assume, therefore, that static is due to strongly damped non-oscillatory pulses. Evidence from other sources|| points to the same general conclusion with regard to lightning discharges. Turner‡ states that "lightning fields are known to die away in 1/1,000 to 1/10,000 second, corresponding to (say) $\alpha = 5{,}000$ to 50,000, and are almost certainly non-oscillatory." It is simplest to represent the field due to these "dead-beat" pulses by $E\epsilon^{-\alpha t}$. This is the assumption made by Abraham in his paper in the *Jahrbuch*, and is adopted as typical of static in what follows.

### Response of Tuned Circuit to Static Pulse.

Let a circuit of inductance $L$, capacity $C$, and total resistance $R$ be subjected to the e.m.f. shown in Fig. 1, which may be expressed as :—

$$\left.\begin{array}{l}\text{e.m.f.} = E\,\epsilon^{-\alpha t}, \quad - - - - \quad t > 0 \\ \text{e.m.f.} = 0 \quad , \quad - - - - \quad t < 0\end{array}\right\} \quad . \quad . \quad . \quad (1)$$

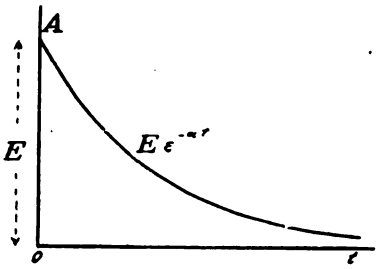

*Fig. 1*

The circuit equation is :

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{C}q = E\epsilon^{-\alpha t} \quad . \quad . \quad . \quad . \quad (1a)$$

where $$I = \frac{dq}{dt}.$$

For the initial conditions $t = 0, q = 0, i = \frac{dq}{dt} = 0$, the solution is

$$i = \frac{E}{L[b^2 + (\alpha - a)^2]} \cdot \left[ -\alpha\epsilon^{-\alpha t} + \frac{\sqrt{a^2 + b^2}\sqrt{b^2 + (\alpha - a)^2}}{b}\epsilon^{-at}\cos(bt + \Theta) \right] \quad . \quad . \quad (1b)$$

where $a = \frac{R}{2L}$, $b = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$, $\Theta = \tan^{-1}\left[\frac{a(\alpha - a) - b^2}{b\alpha}\right]$.

Abraham's choice of initial conditions is

$$t = 0, \qquad i = 0, \qquad \frac{di}{dt} = 0,$$

and accounts for the discrepancies pointed out below. The total energy, $Q_0$, delivered to the circuit

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* Received March 6th, 1922.

† M. ABRAHAM, "Die Spule im Strahlungsfelde, verglichen mit der Antenne." (*Jahrbuch der drahtlosen Telegraphie und Telephonie*, 14, pp. 259-269, August, 1919).

‡ L. B. TURNER, "Optimum Wavelength and Atmospherics." (*Radio Review*, 2, pp. 524-534, October, 1921.)

§ L. W. AUSTIN, "The Relation between Atmospheric Disturbances and Wavelength in Radio Reception." (*Proceedings of the Institute of Radio Engineers*, 9, pp. 28-40, February, 1921.)

|| E.g., Humphreys' "Physics of the Air," and C. T. R. WILSON, Investigation of Lightning Discharges and the Electric Field of Thunderstorms, (*Philosophical Transactions of the Royal Society*, 211A, pp. 73-115).

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is $Q_i = \int_0^\infty i^2 R dt$. Assuming now, as Abraham does, that $a << b$, and $a << \alpha$, it readily follows that

$$Q_i = \frac{E^2}{2L(\omega^2 + \alpha^2)} = \frac{E^2}{2L} \cdot \frac{\lambda^2}{4\pi^2 c^2 + \alpha^2 \lambda^2} \quad \ldots \ldots \ldots \ldots \quad (2)$$

where $\omega = \frac{1}{\sqrt{LC}}$, $c$ = wave velocity, $\lambda$ = wavelength.

If now $Q_i$ be taken as a measure of the static intensity in a tuned aerial, and plotted as a function of $\omega$ and $\lambda$, curves of the general character indicated in Figs. 2(a) and 2(b) are obtained. Thus on the assumption that $E$ and $L$ are constant, the change in tuning of the aerial being accomplished by varying

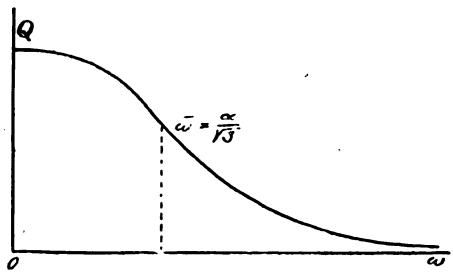


*Fig 2a.*

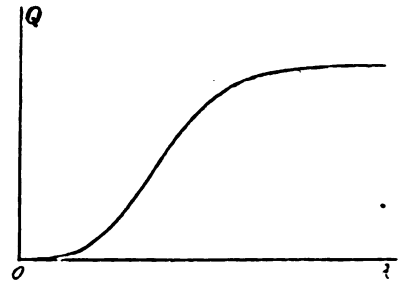


*Fig 2b.*

its capacity $C$, the inflection point on the $Q_i$, $\omega$ curve is given by

$$\frac{\partial^2 Q_i}{\partial \omega^2} = -\frac{E^2}{L} \cdot \frac{\alpha^2 - 3\omega^2}{(\omega^2 + \alpha^2)^3} = 0$$

whence $$\bar{\omega} = \frac{\alpha}{\sqrt{3}}.$$

The general shape of the $Q_i$,$\lambda$ curve bears considerable resemblance to that of Austin's curves. No quantitative conclusions, however, can be drawn from the latter in view of the way they were obtained, under experimental conditions widely different from those assumed here.

A nearer approach to actual conditions is to assume the ratio $\frac{L}{C} = k^2$ to remain constant as the aerial wavelength is being varied. We then have

$$Q_i = \frac{E^2}{2k} \cdot \frac{\omega}{\omega^2 + \alpha^2}.$$

The general shape of $Q_i$ as a function of $\omega$ is shown in Fig. 3. The inflection point is given by

$$\frac{\partial^2 Q_i}{\partial \omega^2} = \frac{E^2}{k} \cdot \frac{\omega(\omega^2 - 3\alpha^2)}{(\omega^2 + \alpha^2)^3} = 0$$

whence $$\bar{\omega} = \alpha \sqrt{3}.$$

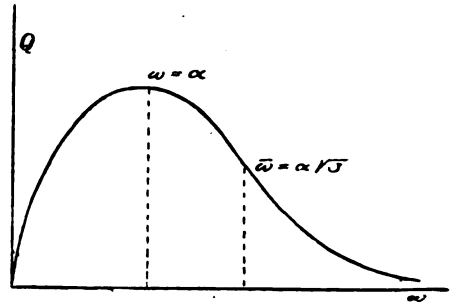


*Fig. 3.*

It must be emphasised that this result is only qualitatively related to data on static audibility obtained with regenerative or heterodyne methods of reception. It would be interesting to have *simultaneous* measurements of the intensity of static impulses made in aerials tuned to distinct frequencies. If the measuring device obeys a square law so that its reading is proportional to $Q_i$ then $\alpha$ could be obtained graphically as above or from

$$\frac{\omega_2^2 + \alpha^2}{\omega_1^2 + \alpha^2} = \left(\frac{Q_1}{Q_2}\right)\left(\frac{E_2}{E_1}\right)^2\left(\frac{L_1}{L_2}\right).$$

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**Static Immunity of Capacity Aerial.**

Let $E_s \cos \omega t$ represent the electric field due to a sustained C.W. signal. The energy, $Q_s$, supplied by it to the aerial during the time $T$ seconds $\left(T >> \frac{2\pi}{\omega}\right)$ is :—

$$Q_s = \frac{h^2 E_s^2}{2R} \cdot T$$

and that due to the static impulse :

$$Q_i = \frac{h^2 E_i^2}{2L(\omega^2 + \alpha^2)}$$

where $h$ = height of the aerial in cms. Defining the interference immunity as $S_m = \frac{Q_s}{Q_i}$ we find for the capacity aerial :—

$$S_m = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \left(\omega^2 + \alpha^2\right) \cdot T \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Abraham's result for this case is

$$S_m = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \frac{\omega^2}{\alpha^2} \cdot \left(\omega^2 + \alpha^2\right) \cdot T \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4a)$$

The additional factor, $\frac{\omega^2}{\alpha^2}$, is introduced through the choice of initial conditions referred to above.

If now Table II in Turner's paper be recomputed on the basis of equation (4) rather than (4a) the following is obtained (on Abraham's additional assumption $\alpha^2 << \omega^2$) :—

TABLE I.

| Range $X$ in km. | Optimum Wavelength in km. | |
|---|---|---|
| | Austin-Cohen. | Fuller. |
| | Capacity Aerial. | Capacity Aerial. |
| 3,000 | 2·25 | 6·06 |
| 4,000 | 4·0 | 7·35 |
| 5,000 | 6·26 | 8·65 |
| 10,000 | 25·0 | 14·1 |

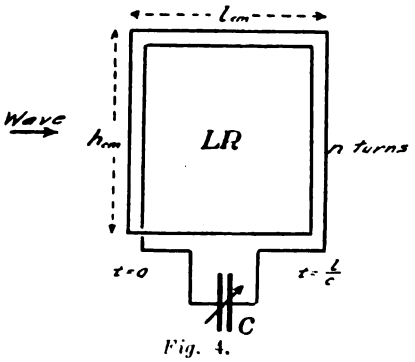

*Fig. 4.*

For purposes of comparison the corresponding table based on Abraham's result, is reproduced :-

TABLE II.

| Range $X$ in km. | Optimum Wavelength in km. | | | |
|---|---|---|---|---|
| | Austin-Cohen | | Fuller. | |
| | Loop. | Capacity Aerial. | Loop. | Capacity Aerial. |
| 3,000 | 0·40 | 0·81 | 3·3 | 1·2 |
| 4,000 | 0·71 | 1·44 | 4·05 | 5·1 |
| 5,000 | 1·10 | 2·25 | 4·8 | 6·0 |
| 10,000 | 4·4 | 9·0 | 7·8 | 9·8 |

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**Interference Immunity of Loop Aerial.**

Abraham's solution for the loop assumes the same initial conditions as in his treatment of the capacity aerial. In what follows the initial conditions $t = 0, - - - q = 0, i = \frac{dq}{dt} = 0$, will be used. Another modification also appears necessary in order properly to represent the history of the transient e.m.f. acting in the loop.

Regarding the loop (Fig. 4) as two vertical aerials, $h$ cm high and $l$ cm apart, the e.m.f. due to a sustained signal is given by

$$E_s.n.h \cos \omega t - E_s.n.h. \cos \omega(t - \frac{l}{c}),$$

where $c$ = velocity of wave propagation.

Assuming $\frac{\omega l}{2c} << 1$, this becomes

$$E_s.n.h. \frac{\omega l}{c} .sin\ \omega(t - \frac{l}{c}).$$

The energy supplied to the loop circuit during the time $T$, $(T >> \frac{2\pi}{\omega})$, is given by $\int_0^T i_s^2 R\, dt$

which is: $$Q_s = \frac{E_s^2 n^2 h^2 l^2 \omega^2}{2 R c^2} . T.$$

Let the static impulse again be of the type given by equation (1). The two e.m.f's. acting in opposite directions are ABE and GH (Fig. 5). The resultant e.m.f. acting in the loop is given (in absolute value) by ABCD, where

$$|ICD| = |FGH| - |ABE|. \text{ (Fig. 5).}$$

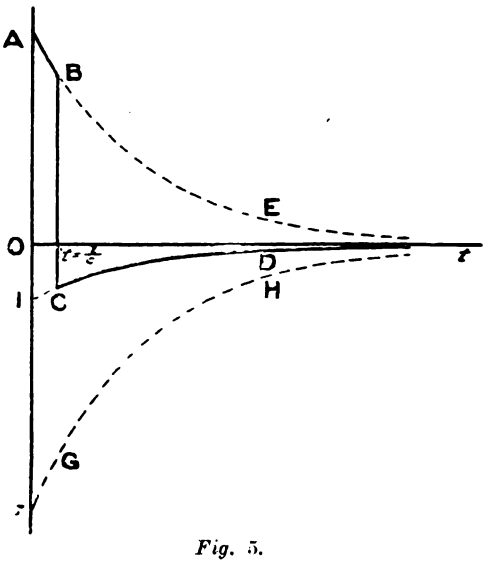


*Fig. 5.*

or by

$$E_1 + E_2 \quad E_i n h \left[ \epsilon^{-\alpha(t-l/c)} - \epsilon^{-\alpha t} \right]_{0<t<\infty} - E_i n h\ \epsilon^{-\alpha(t-l/c)} \Big]_{0<t<\frac{l}{c}} \quad . \quad (5)$$

In Abraham's solution the ICD curve is taken to represent the e.m.f. acting throughout, the second term, $E_2$, in equation (5) being neglected. The exact evaluation of the energy delivered by $(E_1 + E_2$ to the loop circuit leads to a rather complicated expression. If, however, Abraham's assumptions of $a << b$, $a << \alpha$, $\frac{\alpha l}{c} << 1$, and $\frac{\omega l}{c} << 1$ are adhered to, the calculations become simple. In that case the method used in deriving equation (2) from (1b) is directly applicable whence

$$Q_i = \frac{E_i^2 n^2 h^2 \omega^2 l^2}{c^2} \cdot \frac{1}{2L(\omega^2 + \alpha^2)}$$

and for the loop aerial interference immunity

$$S_L = \frac{Q_s}{Q_i} = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \left(\omega^2 + \alpha^2\right) \cdot T$$

which is the same as was found for the interference immunity of the capacity aerial. Abraham's result for this case is

$$S_L \quad \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \frac{\omega^4}{\alpha^4} (\omega^2 + \alpha^2) . T.$$

It follows that the "best wavelength" values in Tables II and IV of Turner's paper are replaced by those in Table I above for loop and capacity aerial alike. Of course, the directive properties of the vertical aerial and of the loop were not taken into account in the computation of their interference immunities. Their effect will depend on the spatial distribution of the atmospheric disturbances but can not appreciably modify the above conclusions in so far as wavelength is concerned.

RESEARCH LABORATORIES OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, AND THE WESTERN ELECTRIC COMPANY, INC.

*October 17th*, 1921.

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# Fine Adjustments of Tuning for Telephony

By G. P. KENDALL, B.Sc.

SUCCESS in the reception of telephony depends to a very great extent upon the use of the minimum amount of amplification necessary to give signals of fair strength; in this way alone can one secure any degree of freedom from interference by Morse signals, atmospherics, induction from power mains, radiating valve circuits, and all the other things which the learned call "extraneous noises," but which the harassed owner of a seven-valve set is apt to describe much more forcibly when he has to snatch the telephones from his deafened ears on nights when Mars is coming in particularly well. Since, then, as few stages of amplification as possible are to be used it is obvious that the tuned circuits must be operated with the greatest possible efficiency, and devices for fine adjustments of inductance and capacity become essential. When reaction is used, of course, a further device is needed for giving fine adjustments of the degree of coupling. A good method was described in *The Wireless World* for November 26th, 1921.

## ADJUSTMENTS OF INDUCTANCE.

Since the inductance changes required on telephony wavelengths are fairly small, the variometer probably offers the best solution of the problem. As, however, it is usually convenient to design one's short wave tuner to cover, say, 300 to 1,500 metres, this statement must be modified, for a variometer to cover that range would have to be capable of giving such large variations of inductance as to rule out the possibility of fine adjustment (unless, of course, it were fitted with some form of general slow motion, which is beyond the powers of most amateurs, since it has to be of great mechanical perfection to be any use). A very satisfactory tuner to meet the aforementioned requirements may be made by combining the tapped form of inductance with a small variometer in some such way as this:—Wind a 12 × 3 inch, or an 8 × 4 inch tube, with a single layer of No. 22 D.C.C. wire, taking a tapping from every fifteenth or tenth turn respectively, to a stud of a switch; this gives the rough variation of inductance. For its finer adjustment, arrange inside one end of the tube (the end which remains in circuit on minimum adjustments) a small coil of about ten turns on a spindle, to which is fixed a long handle of the usual anti-capacity type. This little rotary coil, being connected in series with the main coil, provides by its variometer action a very fine inductance adjustment, which should comfortably cover the gaps between tappings.

With a tuner of this type a variable condenser is not really necessary, but is nevertheless desirable, to enable the operator to make wide sweeps when searching for a station, and consequently to pick up that station quickly, which is of great importance in telephony.

It should be noted that this tuner does not lend itself to having a reaction coil combined with it, because the magnetic fields of the variometer and reaction coils must necessarily interlink, and hence every slight adjustment of the one will upset that of the other in a vexatious manner. For this reason and others it is much better to use a separate reaction coupler whose aerial circuit coil has a fixed value. A suitable design follows for a coupler to cover the same range of waves as the tuner previously described:—

Aerial coil: 20 turns of No. 22 D.C.C. wire (*i.e.*, about 2 cms. of winding) on a former of about 3 inches diameter, mounted on a spindle (with anti-capacity handle) so as to rotate within the plate coil.

Plate coil: a single layer of No. 30 D.C.C. wire upon a 4 × 8 inch tube, with six equal tappings taken to studs of a switch. A small variable condenser should be placed across this coil for the purpose of tuning the plate circuit more or less exactly to the received wavelength, since somewhat better results are obtained in this way. Fig. 1 shows how these components may best be arranged in circuit so as to minimise capacity effects from the hand.

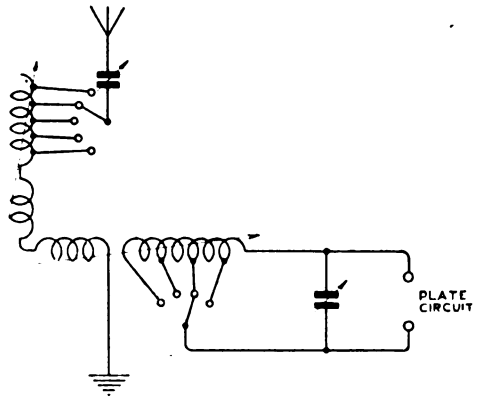


*Fig.* 1.

It should be noted that the reaction coil here specified is intended to be used for purposes of amplification only, and *not* for the production of heterodyne current. (The man who operates such a circuit in the self-oscillating condition on telephony wavelengths would have his licence suspended in a world wherein everyone got his deserts.) When a heterodyne current is required for searching for carrier-waves or the reception of C.W., it should be provided by a separate heterodyne set and introduced into the amplifier at a point as remote from the aerial circuit as possible. For example, if a transformer-coupled H.F. amplifier is used, the heterodyne set should be coupled into one of the inter-valve transformers. This is really the only considerate method, but since it can be used with H.F. amplifying sets only, it is out of reach of the numerous amateurs who are limited to a single valve, with reaction, possibly followed by L.F. amplification. The proper course in this case

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is to employ two tuned circuits, as loosely coupled as possible, and to react into the secondary, NOT the aerial circuit. The only alteration required to make the previously described reaction coupler suitable for this purpose is to wind the rotary coil (which is now to be placed in series with the secondary of the loose-coupler) with 30 turns of No. 28 D.C.C. wire. Fig. 2 shows how the components should be arranged in circuit to minimise objectionable capacity effects. An improvement is shown in Fig. 3, where the coupling of aerial and secondary circuits is done by means of a small fixed aerial coil mounted on a spindle inside the secondary coil, tuning of the aerial circuit being

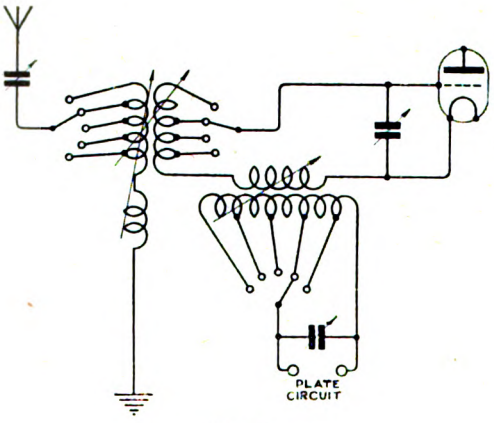


*Fig. 2.*

done with the tuner already described. In this way tuning and coupling are kept separate and distinct, so that one can adjust the one without upsetting the other. The additional complication of the set which results, objectionable though it may seem, is well worth while from the point of view of the amateur who aims at getting the best possible results from his set. Suitable dimensions for the loose coupler follow :—

Aerial coil : 15 turns of No. 22 D.C.C. on a 3 inch rotary former inside one end of the secondary.

Secondary coil : single layer of No. 28 D.C.C. on a 4 × 9 inch tube, with about six tappings, the actual number depending upon the capacity of the variable condenser which is to be used.

The reader will have observed that I specify double cotton-covered wires for all windings : this is done advisedly, in order to draw the attention of those amateurs who use silk-covered wire to the advantages of the former type of covering. A good deal of experience has led me to the conclusion that double cotton is much the best covering for wires for almost all types of tuning coils, since it is both cheaper and more efficient than silk. Its greater efficiency is due to the fact of its greater thickness, giving a better spacing of adjacent turns, and a correspondingly reduced internal capacity, this being especially noticeable in any type of multi-layer coil. Of course, the resulting coil is more bulky, but every amateur of any experience knows that he must not expect a really efficient set to be suitable for the waistcoat pocket.

As for insulation, the relative insulating and hygroscopic properties of silk and cotton are of little importance, since the finished winding will in any case be thoroughly dried and then impregnated with shellac varnish or paraffin wax. The last-named is perhaps the best insulator for the purpose, because both the coil and the former upon which it is wound can be soaked in the melted wax until thoroughly impregnated (*i.e.*, until air-bubbles cease to rise). The result, when the coil is taken out, drained of superfluous wax as completely as possible and allowed to cool, is a perfectly permanent and damp-proof impregnation of the highest insulation.

## ADJUSTMENTS OF CAPACITY.

The ordinary type of rotary variable condenser does not give a sufficiently gradual variation for telephony purposes, and some form of fine adjustment is extremely desirable, although it can be dispensed with if really good variometer tuning is employed. Many amateurs, however, prefer to use merely a tapped inductance and to get their fine adjustments of wavelength with the condenser.

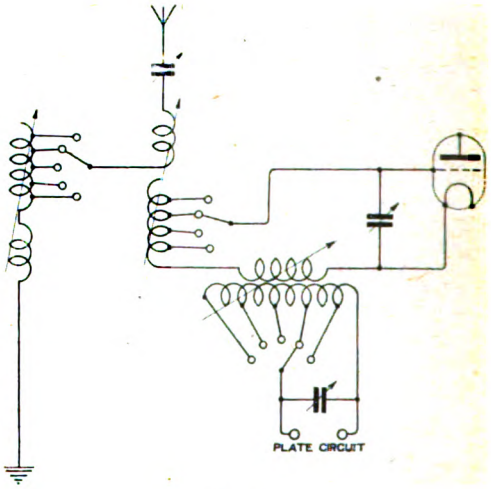


*Fig. 3.*

There are three principal methods of attaining the desired end, two of which are in common use, while the third, which I have found to be decidedly the best, seems to be very little known. The first method is that known as the Vernier condenser ; this, correctly, means that an ordinary tuning condenser is fitted with a geared slow motion, by means of which the rotary plates may be very gradually turned, and a vernier scale to indicate their position with great exactitude. This is quite a good method, but it is really only suitable for the amateur with a pocket of considerable depth, since the gearing must be of the highest possible quality to ensure that there shall be no " back-lash " or looseness in its working, the slightest trace of which would be sufficient to render the condenser useless for the purpose for which it is intended.

The most popular method is one depending upon the use of a very small variable condenser

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(sometimes erroneously called a vernier condenser), having, say, three fixed and two moving vanes; this condenser is connected in circuit in a variety of ways, and provides a fairly satisfactory method of fine tuning. When connected in parallel with the inductance it may be used either alone or in parallel with a larger condenser, both arrangements having drawbacks. The defect of the first is that it is incapable of giving those wide sweeps which are essential to picking up stations quickly, while the second is objectionable on the score of expense. It is, however, very convenient to work with, the large condenser being used for rough adjustments and the small one for fine tuning. When working with the capacity in series with the inductance the small condenser cannot, of course, be used alone, but must be placed in parallel with a larger condenser, which may be either fixed (say, 0·001 mfd.) or variable (preferably). The reader will see that the same objections apply to these two arrangements respectively as to the preceding two.

The third method is simplicity itself. It is based upon the fact that if two condensers are placed in series the resulting capacity in circuit is less than that of either of the two separate condensers (actually, it is the reciprocal of the sum of the reciprocals of the separate capacities). Now, if one wishes to connect an ordinary variable condenser of, say, 0·0005 mfd. capacity in circuit in such a way that the total capacity shall have a maximum value of about 0·00005 mfd., and be very gradually variable between that value and a very small minimum, all that is necessary is to place in series with the variable condenser a fixed condenser of suitable (very small) capacity. Since the whole scale of the condenser then only represents a variation of zero to 0·00005 mfd. it is evident that we have here the desired fine adjustment. The method has many advantages, of which the following are the chief ones:—

(1) Cheapness. Total cost is perhaps sixpence.

(2) Capacity effects from the hand are much reduced, provided that the fixed condenser is put on the *aerial* side of the variable condenser, and not the earth side.

(3) The insulation of the variable condenser (a doubtful quantity in many cases) is increased by that of the fixed condenser, which is easily made very high.

(4) When using the tuning condenser in parallel with the inductance, the device automatically ensures that only small values of capacity are used, thus compelling one to keep to an efficient ratio of inductance to capacity.

(5) Only one variable condenser is needed to give either rough or fine adjustment. Fit a two-point switch to put the stopping-down condenser in or out of circuit as required; signals can then be picked up in the ordinary way, inductance increased and capacity decreased until they are heard near the zero end of the condenser scale, and then the stopping-down condenser inserted and final exact adjustments made.

What has been said so far about this method applies mainly to its use when the capacity is in parallel with the inductance. When the condenser is to be in series it is evident that some modification is required, since a capacity in that position must be large. What is needed is another fixed condenser of about 0·001 mfd., in parallel with which is to be placed the variable condenser with its stopping-down condenser and two-stud switch as before. Coarse and fine adjustments can then be obtained, and tuning in be done, exactly as already described. Fig. 4 will make the arrangement clearer than a detailed description.

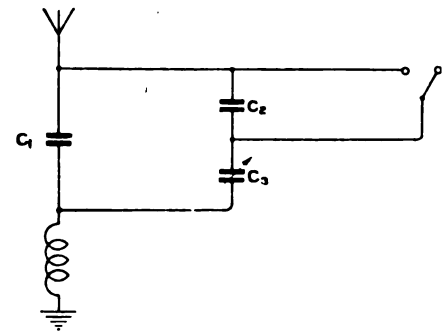


*Fig.* 4.

$C_1$ is the large fixed condenser (0·001 mfd.), $C_2$ the stopping-condenser (0·0001 mfd.), and $C_3$ is variable (0·0005 mfd. max.). The values given are probably about the best to work with, since they give somewhere about the right degree of fine and rough adjustment. Although this arrangement seems a little complicated, it is really only so on paper; once connected up it is perfectly simple and satisfactory to use.

A practical point to note is that mica is not a desirable dielectric for the small fixed condenser, because it necessitates the use of such small plates that exact calculation becomes impossible, and one has to trust to luck in hitting the right capacity. The best materials for the purpose are, I suggest, copper foil and thin sheet ebonite (1/64th inch is the best).

The actual capacity of the stopping-down condenser may be suited to such individual requirements as the amount of capacity variation needed to cover the intervals between studs on one's tuner. A good general value is that already mentioned, namely, 0·0001 mfd.

## The Wireless Society of London.

The last Meeting of the Session will be held on Wednesday, June 14th, at 6 p.m., at the Institution of Electrical Engineers, when an address will be given by Sir Oliver Lodge, F.R.S.

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# A Simple C.W. and Telephony Transmitter

BY B. J. AXTEN.

THE following is a description of a C.W. and telephony transmitter which can be built very easily and has given the writer great satisfaction. It is both simple and inexpensive to make and maintain, and most of the components are to be found in any amateur station.

The set takes small power, which although not giving a long range, keeps the cost of construction and maintenance low; also, for the purpose for which it is designed (*i.e.*, to give a practical knowledge of transmission to amateurs with little previous experience), high power and long range are unnecessary. Instructive, useful and interesting experiments and tests can be carried out with this set with the co-operation of local amateurs, and when the owner is tired of the limitations of the set, he will be in a suitable position to work a more powerful set. Yet another advantage of commencing operations on low power is that any interference the owner may cause by his ignorance will be far less serious than if he started right away with considerable power.

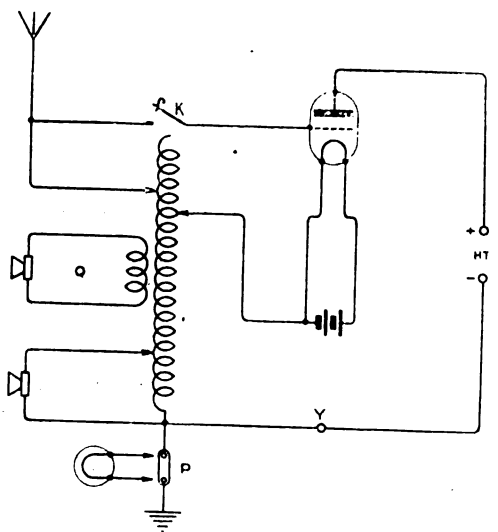


*Fig.* 1.

Fig. 1 shows a diagram of the transmitting circuit proper. The inductance consists of a former (diameter 3") wound for 13 centimetres, with No. 26 S.W.G. enamelled wire. This will give well over 1,000 metres, but the actual wavelength will depend upon the capacity of the aerial in use. Cardboard or wooden formers will be quite satisfactory if well soaked in paraffin wax or shellaced. Ebonite is preferable, of course, but is more expensive and, in the writer's opinion, its use for the purpose in hand does not warrant the extra cost.

The original coil was fitted with three sliders, one for regulating wavelength, one for adjusting the position of the centre tapping and one for adjusting the position of the microphone contact. I would advise other amateurs to profit by my experience and use tappings instead of sliders, as the latter do not work satisfactorily. In constructing my second tuner I took tappings at every ten turns.

As will be seen from the diagram, the key, K, is inserted in the grid circuit, being connected between grid and aerial.

The valve used is an ordinary receiving valve ("R" type), with about 4 volts on the filament, although 5 volts can be used safely. The application of more than 5 volts to the filament, whilst giving a greater plate current, tends to decrease the length of life of the valve. However, it is desirable to use as much filament current as safety will allow to avoid saturation-point effects, because it is useless to increase the H.T. voltage beyond the voltage at which saturation point is reached, *i.e.*, when all electrons from the filament are attracted to the plate. The increase of filament current produces a greater emission of electrons, thus causing a greater current to flow in the anode circuit.

The microphone is a watch-case type instrument, with replaceable inset, and was obtained for the modest sum of 2s. 6d. through advertisement in *The Wireless World*. Good speech has been obtained with it, although one inset is often decidedly better than another. One connection is made to the metal case and the other to a contact inside the case. The lead from the metal case should be the earthed one, to avoid capacity effects of the hand when speaking. The other lead, from the microphone, goes to one of the inductance sliders, adjustment of which is necessary to obtain the best speech. Different type microphones have different resistances, and it is therefore necessary to experiment with the position of the slider for each type of microphone tried. The microphone can also be tried in series with the earth lead by inserting it at P, or by coupling it inductively to the main inductance, as at Q.

In wiring up the set the various components should be mounted reasonably close together. The microphone leads should be kept short, to minimise the capacity between them.

With regard to the high-tension supply, a battery of dry cells of about 120 volts can be used very satisfactorily. Any other D.C. supply, of course, will be suitable if above about 100 volts.

An important feature of the set, however, is that it can be used with great success when the plate voltage is derived from A.C. mains. Results are very good and this source of H.T. supply is cheap.

The A.C. mains in my locality are 240 volt, 50-cycle, 3-wire system. To use them for H.T. supply the addition of the apparatus shown in Fig. 2 is necessary.

Another "R" valve is needed, of ordinary-

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receiving type, to rectify the A.C., and a 3 mfd. condenser to smooth out the rectified current.

The plate and grid of this rectifying valve are connected together, thus the valve functions purely as a 2-electrode valve. The anode is connected to one lead of the A.C. mains, the other lead going to the negative H.T. terminal of the transmitter proper. The positive H.T. terminal of the transmitter is connected to the + side of the rectifier valve's filament battery.

The smoothing condenser is connected in parallel with the H.T. terminals of the transmitter. In the original set a 3 mfd. Mansbridge was used, and worked perfectly well, being obtained for 1s. 6d. from a well-known dealer. This condenser smooths out the A.C. hum excellently, enabling telephony to be carried out. If the condenser is diconnected tonic-train transmission is obtained.

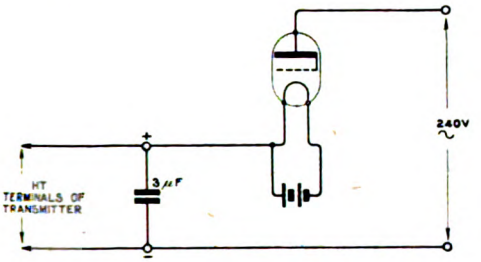


*Fig.* 2.

In my district the supply is on the 3-wire system, one wire being earthed. Unfortunately the same wire is not always the earthed one. Now, when A.C. mains are used for the H.T. supply, the A.C. lead connected to the negative H.T. terminal of the transmitter goes to earth, as will be seen from the figures. This is all right if one happens to connect up the A.C. leads the right way round, but if the unearthed A.C. lead is connected to the negative H.T. terminal it short-circuits, and the fuse goes. One can find out the right way round by experiment, but in my district even this is of no use, since the A.C. leads may change their connections to earth without warning. This difficulty was overcome by inserting an ordinary lamp in the point marked Y (Fig. 1). If the A.C. lead to the + H.T. becomes the earthed one, instead of a short-circuit and consequent blowing of fuses taking place, the lamp lights up, indicating that the A.C. leads must be reversed, which will put matters right. It will be seen that the lamp is always in the anode circuit. This does not matter, however, as the lamp's resistance is of about 800 ohms, whereas the rest of the anode circuit's resistance is about 20,000.

Separate accumulators must be used for the power and rectifier valve filaments, otherwise the centre tapping of the inductance would become connected to the positive H.T. terminal, which would short-circuit the plate-to-filament circuit of the power valve.

I hope later to give some figures showing the distances at which the above transmitter has been heard. I shall be interested in the results obtained by anyone making up a set as described above.

# Home-Made Three-Valve Set

By G. T. SINDALL.

ALTHOUGH nothing unusual is claimed in the construction or design of this set, it is thought it may be of interest to amateurs in the early stages of their progress in wireless.

The apparatus consists of one H.F. resistance coupled, one rectifying and one L.F. valve, and is entirely home-made, with exception, of course, of the telephones, valves and transformer (L.F.). The whole is mounted at the back of an ebonite panel of a cabinet, 18″×9″×5″ (Fig. 1).

The anode resistance is made from a piece of ebonite 3″×¾″, with a groove cut in it 1½″ long, into which graphite was rubbed until a suitable value was obtained, and is as near to 80,000 ohms as possible, as the writer was afterwards able to have it tested. The grid leak is about 3 megohms and was made in the same manner as the anode resistance. The filament resistance was reconstructed from an old pattern, which had the knob at the front, and was reversed to allow of mounting at rear of panel. The coupling condenser, $C_1$, is composed of three strips of tinfoil 2½″×½″, with 1″ overlap, interleaved with waxed paper and clamped between ebonite plates. The condenser, $C_2$, is the same size, but with six strips of tinfoil. By adding this, condenser signals were found to be better. The variable condenser (A.T.C.) is entirely home-made and has 14 moving vanes and 15 fixed, cut from sheet zinc 1/64″ thick, with snips and holes for supporting rods of fixed vanes

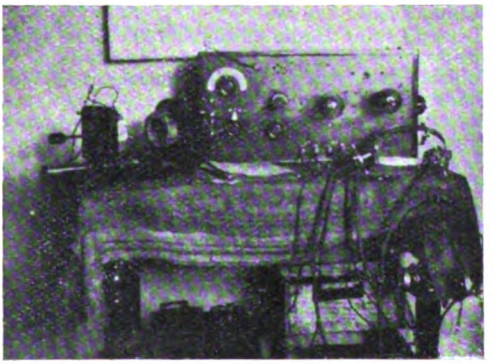

*Fig.* 1.

drilled out whilst held firm in vice. The square holes for spindle of moving vanes were drilled ¼″ diameter and afterwards filed square. The spacing washers were cut from brass tube and are ⅛″ thick. To obtain the vanes perfectly flat they are slightly heated, being the while firmly held in a vice and allowed to cool off before being taken out. The internal connections, shown in Fig. 2, are made with No. 16 S.W.G. enamelled wire, thus ensuring stiff connections, as the writer has found that loose and flapping wires are most conducive to a silent set. The condenser, $C_3$, across A.T.C. is switched in or



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out by the switch seen in photograph under the variable condenser.

The inductances are honeycomb and made from instructions given in a recent article by Mr. Philip Coursey in *The Wireless World*, connection to panel being by means of flex and plugs. The tuning stand in photograph is arranged so that reactance coil is moved to and fro from A.T.I. by means of knob on extreme left of photograph. The first valve is an E.S.2, the second and third French "R" type. The knob under first valve is the filament resistance controlling rectifying valve filament. The switches on right of the cabinet being for H.T. and L.T. current.

The set is fairly silent in working, and most Continental stations are audible with telephones (8,000 ohms) on table, Paris and Leafield being easily read on next floor. Croydon telephony is quite loud here in the Midlands, and the Dutch Concert quite clear and about half the strength of Croydon. The circuit is given in the accompanying diagram.

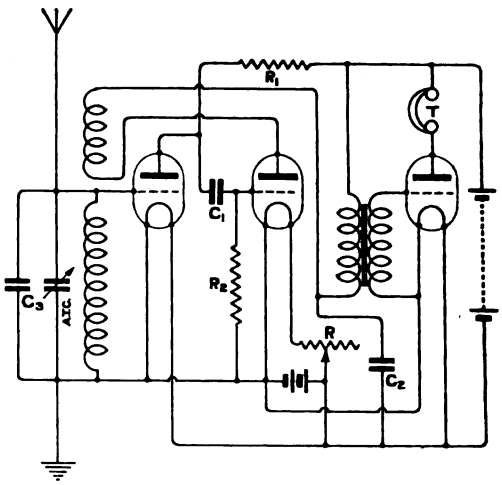


*Fig. 2.*

# Wireless Societies of the United Kingdom

*(Continued from last issue.)*

Leamington Spa and Warwick Wireless Society, 13, Archery Road, Leamington Spa.

Leeds District Wireless Society, 37, Mexborough Avenue, Leeds.

Leicestershire Radio Society, 269, Mere Road, Leicester.

Lincoln and District Wireless Society, 168, West Parade, Lincoln.

Liverpool Wireless Association, Avondale, Knowsley Road, Cressington Park, Liverpool.

Loughborough College Wireless Society, The College, Loughborough.

Lowestoft and District Wireless Society, "Gouzea-court," Chesnut Avenue, Oulton Broad.

Luton Wireless Society, Hitchin Road Boy's School, Luton.

Manchester Wireless Society, 2, Parkside Road, Moss Side, Manchester.

Radio Scientific Society of Manchester, 16, Todd Street, Manchester.

Merchant Taylors' Wireless Scientific Society, Merchant Taylors' School, Charterhouse Square, E.C.1.

Middlesborough and District Wireless Society, Borough Road East, Middlesborough.

Newcastle Wireless Association, 51, Grainger Street, Newcastle-on-Tyne.

Newark-on-Trent Wireless Society, 6, Beach Avenue, Hawtonville, Newark-on-Trent.

The Newbury and District Wireless Club, 86, North Brook Street, Newbury.

North Essex Wireless and Scientific Society, 15, Rayne Road, Braintree.

North London Wireless Association, c/o Superintendent, Peabody Buildings, Essex Road, N.

North Middlesex Wireless Club, Nithsdale, Eversley Park Road, Winchmore Hill, N.

North Staffs Railway Electrical Department Wireless Society, 87, Spencer Road, Shelton, Stoke-on-Trent.

Nottingham and District Radio Experimental Association, 22, Cranmer Street, Nottingham.

Radio Experimental Association (Nottingham and District), 157, Trent Boulevard, West Bridgford, Notts.

N.S. Railway Wireless Society, 87, Spencer Road, Shelton, Stoke-on-Trent.

Oldham Lyceum Wireless Society, Oldham Lyceum, Union Street, Oldham, Lancashire.

Paddington Wireless and Scientific Society, Paddington Technical Institute, Saltram Crescent, W.9.

Plymouth Wireless and Scientific Society, 9, Ryder Road, Stoke, Devonport.

Portsmouth and District Wireless Association, 34, Bradford Road, Southsea.

Preston Scientific Society, 119a, Fishergate, Preston.

The Dick Kerr Wireless Society, Ashton Park, Ashton-on-Ribble, Preston.

Reading Radio Research Society, 73, London Street, Reading.

Redhill and Reigate Wireless Society, 111, Station Road, Redhill.

Richmond and Kew Wireless Society, 14, Forest Road, Kew.

Rugby and District Wireless Club, 3, Charlotte Street, Rugby.

The Border Wireless Club, The Square, Kelso, Scotland.

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Sheffield and District Wireless Society, 156, Meadow Head, Norton Woodseats, Sheffield.

Slough, Windsor and District Wireless Society, Caversham House, Dolphin Road, Slough.

South Hackney Wireless Society, 48, Dagmar Road, South Hackney, E.1.

Southport Wireless Society, 5, Tower Buildings, Leicester Street, Southport.

Sussex Wireless Research Society, Technical College, Brighton.

Stockport Wireless Society, Mersey Chambers, King Street East, Stockport.

Sunderland and District Amateur Radio Society, 15, Ridley Street, Southwick-on-Wear.

Scarborough and District Wireless Club, School House, Snainton, Scarborough.

Smethwick Experimental Wireless Club, Radio House, Wilson Road, Smethwick, Staffs.

Southend District Wireless Club, 21, Oakleigh Park Drive, Leigh-on-Sea.

Southampton and District Wireless Society, 24, Floating Bridge Road, Southampton.

South Woodford Radio Society, 190, Hermon Hill, South Woodford, Essex.

Southwark and District Wireless Society, 178, Walworth Road, Walworth, S.E.17.

St. Austell Wireless Club, 26, Fore Street, St. Austell, Cornwall.

Stoke-on-Trent Wireless and Experimental Society, 360, Cobridge Road, Hanley.

Sutton and District Wireless Society, Elmwood Lodge, Benhill Avenue, Sutton.

The South London Wireless and Scientific Society, St. John's Institute, Larcom Street, S.E.17.

The Borough of Tynemouth Y.M.C.A. Radio and Scientific Society, Eynesbury, Cleveland Road, North Shields.

Tunbridge Wells and District Wireless Society, 4, Vale Avenue, Tunbridge Wells.

Borough of Tynemouth Y.M.C.A. Amateur Wireless Society, Y.M.C.A. Buildings, Bedford Street, N. Shields.

Walthamstow Amateur Radio Club, 23, Ardliehg Road, Walthamstow.

Walsall Amateur Radio Club, 17, White Street, Walsall.

The Wallasey Wireless and Experimental Society, 11, Stoney Hay Road, New Brighton, Cheshire.

Wandsworth Common Wireless Club, 9, Birdhurst Road, Wandsworth.

Wandsworth Wireless Society, Technical Institute, High Street, Wandsworth.

Westcliff and District Wireless Club, Devon Lodge, Lydford Road, Westcliff-on-Sea.

Wimbledon and District Wireless Society, 48, Warren Road, Merton, S.W.19.

Wireless Society of London, 32, Quex Road, West Hampstead, N.W.6.

Worcester and District Radio Association, 59, Waterworks Road, Worcester.

Wolverhampton and District Wireless Society, 8, Roseberry Street, Wolverhampton.

West London Wireless Association, 19, Bushey Road, Harlington, Middlesex.

The Willesden Wireless Society, 87, Mayo Road, N.W.10.

Wireless and Experimental Association, 18, Melford Road, S.E.22.

Woolwich Radio Society, 42, Greenvale Road, Eltham, Kent.

York Wireless Club, 16, Wentworth Road, York.

# Amateur Transmissions

## REVISION OF POST OFFICE REGULATIONS.

The following letter has been received from the Postmaster-General by the Wireless Society of London, in reply to Recommendations of the Committee of the Society,* made to the Postmaster-General as a result of the resolutions passed at the third Annual Conference of Affiliated Wireless Societies, held on January 25th, 1922 :—

*To* The Hon. Secretary, THE WIRELESS SOCIETY OF LONDON.

SIR,—With reference to your letter of March 3rd, addressed to Captain Loring, I am directed by the Postmaster-General to say that he has carefully considered the recommendations of the Committee of the Wireless Society of London regarding the regulations governing amateur transmission, and, in reply, to say that, after consultation with the other Government Departments concerned, he agrees that the following modifications shall be made, viz. :—

(1) The restriction that transmission must be confined to five other stations will be withdrawn, on the understanding that the matter transmitted will be confined to communications relating to the experiments in hand and intended solely for the stations actually co-operating in those experiments. The broadcasting of general calls, news, or advertisements, or of matter similar to that which will be transmitted from the proposed broadcasting stations, will be expressly forbidden.

(2) Transmission will be permitted for an aggregate maximum of two hours in each 24 hours provided—(*a*) that no transmission shall commence without previous listening-in on the wavelength which is to be used in order to ascertain whether the proposed transmission is likely to interfere with any other station which may be working, and (*b*) that no single transmission shall last more than 10 consecutive minutes, and each transmission shall be followed by a period of not less than three minutes listening-in on the wavelength used for transmission.

(3) The following wavelengths will be allocated for amateur transmission, viz :—

150 metres to 200 metres inclusive (spark, c.w. and telephony).

440 metres (c.w. and telephony only).

The fixed wave of 1,000 metres will be withdrawn.

A circular letter on the subject will be sent from this Office to all the licensees concerned.

General Post Office, London, *May 19th*, 1922.

I am, Sir, Your obedient Servant,
(Signed) F. J. BROWN.

* See page 108 of the issue of April 22nd, 1922.



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# A Hint to Wireless Traders.

An extension of business which will very soon assert itself will be the demand for efficient and rapid accumulator charging and electricians who lay themselves out to do this will, no doubt, build up a wide connection among wireless enthusiasts in their district.

A brief survey of the numbers interested in the science at the moment and the enormous increase that will without doubt take place in the immediate future indicates that a big business is to be done in satisfying the public wants, and retailers who provide a reliable accumulator charging service will find it thoroughly worth their while and will show their enterprise in keeping abreast of the times.

It behoves every enterprising trader to carry a stock of first-class wireless gear and he should waste no time in rigging up a complete receiving outfit in order that he may demonstrate the reception of the broadcasted telephony and in satisfying the public demand for a knowledge of the subject, he will be establishing himself in the field as a factor of wireless apparatus and will achieve no small amount of notoriety and advertisement.

# Notes

### The Institution of Electrical Engineers.

The result of the ballot for the election of Officers and new Members of Council for 1922-23 is as follows :—

President, Mr. F. Gill; Vice-Presidents, Dr. W. H. Eccles, F.R.S., Mr. A. A. Campbell Swinton, F.R.S.; Hon. Treasurer, Sir James Devonshire, K.B.E.; Ordinary Members of Council: Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, Mr. W. R. Rawlings.

The Council of the Institution of Electrical Engineers have made the following award of premiums for papers read during the session 1921-22, or accepted for publication :—

THE INSTITUTION PREMIUM, Mr. J. G. Hill; AYRTON PREMIUM, Mr. L. H. A. Carr; DUDDELL PREMIUM, Mr. T. L. Eckersley; FAHIE PREMIUM, Mr. E. S. Byng; JOHN HOPKINSON PREMIUM, Mr. F. P. Whitaker; KELVIN PREMIUM, Mr. R. Torikai, PARIS PREMIUM, Mr. J. A. Kuyser; EXTRA PREMIUMS, Mr. J. Anderson, Mr. F. J. Teago and Mr. W. Wilson; WIRELESS PREMIUMS, Mr. E. B. Moullin, Mr. L. B. Turner and Mr. C. S. Franklin; WILLANS PREMIUM (awarded triennially alternately by the Institution and the Institution of Mechanical Engineers), to Mr. K. Baumann.

### Wireless Society for Dublin.

Mr. H. L. Fletcher, of School House, Oundle, Northants, is anxious to get into touch with readers of *The Wireless World and Radio Review* who are resident in Dublin and area with a view to forming a Wireless Society at some future date. Mr. Fletcher would be glad if the following who have made use of the Questions and Answers columns would communicate with him :—

**W.B.B., P.Y.D., W.Mc.N., Prospective, Crystal,** and **Anxious,** all of Dublin.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with interest Mr. Kendall's article on "Faults in Valve Circuits," in the April 22nd issue.

I would like to point out a small error which crept in. On page 96, par. 4(*a*), he said that to test a condenser put some telephones in series with a battery and the condenser, and a faint click should be heard at make and break.

In the case of a perfect condenser there should be a click at make, due to the charging current. When the condenser is charged the current stops and there is *no* click when the circuit is broken. If the circuit is again made there should be no click unless the condenser was discharged in the interval between break and remake.

In most condensers there is some leakage, and therefore there is a faint click at break and also a louder click on remaking the circuit, but the loudest click is heard on making the circuit after completely discharging the condenser.

P. G. A. H. VOIGT.

"Bowdon Mount,"
121, Honor Oak Park,
London, S.E.23.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The publication of Mr. P. R. Coursey's articles on the construction of long-wave heterodynes, together with the increasing appreciation of accuracy of tuning shown by the wireless fraternity, suggest to me that with the co-operation of the more advanced amateurs a useful method of calibrating receivers could be devised.

At the present time the amateur who wishes accurately to calibrate a heterodyne or a receiving set is faced with several difficulties. The number of calibration waves sent out is small. Regular readers of *The Wireless World and Radio Review* are acquainted with these stations from particulars published in your columns, and will agree that such waves are insufficient to provide means of preparing calibration curves. At the same time few amateurs have access to an accurately calibrated standard wavemeter, and many sold are useless for fine work.

My suggestion is that the Wireless Society of London form a committee of voluntary workers who will undertake to measure the wavelengths radiated by those stations easily audible on the average station, and having agreed amongst themselves on the actual wavelengths received, the results of their work should be periodically published in the journal. In this way a large number of accurate readings would be available and any listener could prepare curves for his own coils and condensers with a minimum of trouble. The present published wavelengths are generally given in round figures and form only the roughest guide.

Perhaps other readers will express their opinions on this matter.

REDAX.

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# Book Reviews

DIE DRAHTLOSE TELEGRAPHIE UND TELEPHONIE. By Dr. P. Lertes. (Pp. xi + 152, 8½" × 6", with 45 Figs. *Steinkopff*, Dresden and Leipsig, 1922. Price, unbound, 4s.)

This is Volume 4 of a series of "Wissenschaftliche Forschungsberichte," which are being issued under the supervision of Dr. Liesegang, of Frankfort. According to the introduction, the object of the volume is to give students and others an insight into the manifold developments which have taken place during and since the war, descriptions of which are so scattered throughout various transactions and periodicals that it is difficult to obtain a comprehensive conception of the whole.

To do this satisfactorily in 150 pages, many of which are taken up by lists of references, it would be necessary to assume that the reader already had a good knowledge of the principles of the subject. The author does not make this assumption, but explains with diagrams the difference between a damped and an undamped oscillation; neither does he confine himself to recent developments, but deals with coherers, electrolytic detectors and such-like. The result is that everything is dealt with very superficially and not always clearly. The treatment of coupled circuits, on page 14, is especially vague and misleading. The author gives a fairly unbiased account of the historical development of the subject, except that he follows the usual German custom of comparing the Marconi, or plain aerial, with the Braun, or coupled aerial, with the implication that one company used one type and the other company the other. One excellent feature of the book is the comprehensive alphabetical bibliography at the end of every chapter; this alone is worth the price of the book.

G. W. O. H.

# Calendar of Current Events

**Saturday, June 3rd.**

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

Half-day visit to Aerodrome and Wireless Station, Croydon, by kind permission of the Air Ministry.

**Sunday, June 4th.**

Transmission of Telephony at 3 to 5 p.m., on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, June 6th.**

THE INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2. "The Performance of Radiotelegraphy Transmitters with Special Reference to the Installation at the North Foreland," by Captain Norman Lee. Also a demonstration of a Dynamic Model of Tuned Circuits, by Professor C. F. Jenkins.

THE WOLVERHAMPTON DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton. "The Electron Theory," by Mr. Blakemore. Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

**Wednesday, June 7th.**

NORTH ESSEX WIRELESS SOCIETY.

At the Technical Exhibits Tent, Essex Agricultural Show, Chelmsford. Demonstration of Wireless. (Also on the 8th).

**Thursday, June 8th.**

THE DEWSBURY AND DISTRICT WIRELESS SOCIETY.

7.30 *p.m.*—At Society's new Club Rooms, in South Street, Dewsbury. "Amplification on Short Wavelengths," by Mr. H. F. Yardley.

THE LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"The Thermionic Valve," by Mr. J. F. Turner.

**Friday, June 9th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part I, by Mr. J. Stanley.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"Reception of Wireless Telephony," by Captain F. A. Whitaker, R.E.

**Sunday, June 11th.**

Transmission of Telephony from The Hague, **PCGG**, as above.

**Monday, June 12th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7 *p.m.*—Committee Meeting.

7.30 *p.m.*—Lecture by Mr. W. J. Featherstone.

**Tuesday, June 13th.**

Transmission of Telephony from Writtle, **2MT**, as above.

**Wednesday, June 14th.**

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (tea 5.30 *p.m.*)—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Address by Sir Oliver Lodge, F.R.S.

NORTH MIDDLESEX WIRELESS CLUB.

8 *p.m.*—At Shaftesbury Hall, Bowes Park. "The Townsend Wavemeter and How to Use It," by Mr. L. C. Holton, followed by a Demonstration of the Reception of Telephony for Beginners.

**Thursday, June 15th.**

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Interpretation of Wireless Circuits," by Mr. F. E. Strudt.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston. "Continuation of A.C. Experiments in Relation to W/T.," by Mr. E. F. Clarke.

**Friday, June 16th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part II, by Mr. J. Stanley.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.*—[ED.]

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Wireless Society of London.

The Forty-Eighth Ordinary General Meeting was held on Wednesday, May 24th, at the Institution of Electrical Engineers at 6 p.m.

After the minutes of the previous meeting had been approved and signed the **President** read a letter from the Postmaster-General which had been received in reply to a recommendation from the Society regarding the regulations governing amateur transmission.†

The President then called upon Mr. J. H. Reeves to give his lecture on "Some Effects of Capacity on Mutual Induction, with special reference to their application to the Elimination of Jamming." (For full report see next issue.)

After the discussion which followed the lecture the President announced that the following had been duly elected to membership of the Society:—Robert Donald Spence, Hubert James Powditch, Boirl Thomson Wilson, Lionel Jackson Hughes, Colin Hamilton Gardner, W. Bissett (formerly Associate), to be full Members, and Walter Seppings Tearle to be Associate.

The President announced that the following Societies have been approved by the Committee for Affiliation:—Sunderland Wireless and Scientific Association, Guildford and District Wireless Society, Reading Radio Research Society, Wolverhampton and District Wireless Society, and Stoke-on-Trent Wireless and Experimental Society.

At the close of the meeting the President welcomed the attendance of Signor Bianchi, President of the Radio Club d'Italia, who expressed his appreciation of the reception given him.

The meeting adjourned at 7.30 p.m.

### Willesden Wireless Society.*

The Society met at 25, Station Road, Willesden Junction, on May 16th, when Mr. Mann exhibited a 3-valve low-frequency receiver capable of being used either as a single valve, two-valve or three-valve receiver, the connections being changed for the various adjustments by means of a rotary switch fitted in a very novel and ingenious manner into a small box, the whole being a triumph of workmanship and efficiency. **2FQ** was heard during the earlier part of the evening, and music from **2UV** was picked up on an indoor aerial at the close of the meeting. Gentlemen wishing to join the society are asked to write to Mr. F. A. Tuck, 87, Mayo Road, Willesden, N.W.10, for membership form. All are welcome.

### The Gloucester Wireless and Scientific Society.*

Hon. Secretary, Mr. G. T. Peck, 45, Denmark Road, Gloucester.

The Annual General Meeting of the above Society was held at the Physics Laboratory of Sir Thomas Rich's School on March 20th. A considerable discussion took place regarding the future policy of the Society. The following officers were then elected: President, Mr. C. J. Scott; Hon. Treasurer, Mr. H. Hine; Hon. Secretary, Mr. G. T. Peck. A vote of thanks was passed to the retiring officers for their valuable services in the last two years.

A General Meeting of the Society was held at headquarters on April 3rd, when Mr. C. Minchin gave a lantern lecture on "Dynamo Design." The lecturer, who is a member of the designing staff of a well-known dynamo works, showed himself very familiar with his subject, and demonstrated clearly the principles underlying the designing of a modern dynamo. The Society is promised in the near future a further and deeper lecture on the same subject.

Meetings are held on the first Monday in the month, at 7 p.m., when prospective members are cordially invited to attend.

### The Wireless Society of Hull and District.*

Before an excellent attendance of members, at the meeting of this Society held on April 24th, Major F. Holman gave a demonstration of winding duo-lateral inductance coils by machine. Members were much interested in this piece of apparatus, which has been both designed and constructed at home by Major Holman. A number of coils were neatly and rapidly wound, and the working carefully explained. This gentleman has kindly offered to wind coils of any size for members if they will supply the necessary wire. Mr. G. H. Strong (President) occupied the chair, and at the conclusion of the demonstration proposed a vote of thanks to the Major, which was ably seconded by Mr. J. Nicholas.

Mr. Henry Strong (Vice-President) presided over a fair attendance of members at a meeting on May 8th, when Mr. T. Forster gave an interesting paper on "Some Experiences of a Novice." In the course of his remarks Mr. Forster touched upon some debatable points, such as single layer coils, insulation of aerials, directional effects, etc., which gave rise to much discussion, to which Messrs. J. Nicholson, C. S. Snowdon, W. J. Featherstone and the Chairman ably contributed; and altogether an instructive evening was spent, the only fault being that the lecturer's remarks were far too brief, although, as he explained, the paper had been compiled at very short notice. Mr. Forster was accorded a vote of thanks for his trouble.

A small library of technical works is being formed, and already a number of volumes have been promised by different members. This matter will be dealt with by the Committee at their next meeting. "The Handbook of Wireless Telegraphy and Telephony, 1922," has now been added to the list of volumes in the Reference Department of the Central Free Library, and can be consulted by any persons interested in these subjects. Will all members please note that during the summer months the meetings of the Society will be held on the *second Monday in each month*, at 7.30 p.m., buzzer practice for those desiring same at 7 p.m.

†A copy of the letter appears on page 295.

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The Society continues to make progress, and the membership is now over forty. Any enquiries *re* membership should be addressed to Mr. H. Nightscales (Hon. Secretary), at 16, Portobello Street, Hull, who will be only too pleased to supply full particulars of the Society.

### Luton Wireless Society.*

The Second Annual Exhibition was held on Saturday, May 13th, at the Hitchin Road Boys' School, and attracted a large number of visitors. At the opening, at 3 p.m., the President (Mr. W. H. Cooke, A.M.I.E.E.) gave an account of the development of the Society.

Among the professional exhibits were a display of apparatus and accessories by Mr. W. R. H. Tingey, Radio Constructa goods demonstrated by Mr. Ed. McT. Reece (of Messrs. Butler & Co.), apparatus by Mr. Peto Scott, and a bookstall by the Wireless Press.

The amateur section of the exhibits included multivalve sets by Messrs. Wilding, L. Bird, F. Halstead, A. Tearle, E. A. Mander, G. White, E. Porter, G. Brown, J. Wells, J. Stiles, F. Bonner, and W. F. Neal. Much ingenuity and skill were apparent from their construction.

The club set, a multi-valve instructional set, was an object of admiration. Demonstrations of X-rays were given by Mr. H. S. Shoolbred, A.M.I.E.E., with apparatus kindly loaned by the Bute Hospital. These proved to be very popular items.

Various objects of scientific interest were exhibited, among others being a working scale model of a Vauxhall chassis by Mr. E. W. Fraser, which won the Championship at the recent Model Engineer Exhibition and some excellent working models of engines by Mr. Palmer. Parties were conducted round at intervals by the Hon. Secretary.

At 6 p.m. telephony was received from Paris, to the delight of a large audience, and at 7 p.m. a popular demonstration and lecture was ably given by Mr. Tingey. A short address was given by the Mayor of Luton, and signals and telephony from a London station provided interesting entertainment until the close.

### Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting was held at the Leeds University on Friday, May 12th, Captain F. A. Whitaker, R.E. (Vice-President) taking the chair at 8 p.m. The Chairman called upon Mr. H. F. Yardley, A.M.I.R.E., to deliver a paper on "The Principles of Tuning."

Mr. Yardley described the term "tuning," and laid emphasis on the fact that it is essential for a beginner to learn to appreciate the use of the $1885 \times LC$ formula at the outset of an amateur wireless career. The majority of beginners pay too much attention to their filament resistances and such like, and only turn their attention to the inductance and capacity of their circuits when absolutely forced. He described the value of resonance curves, and gave blackboard sketches of these curves with their circuits to which they are due. After describing the double-humped wave effect of tightly coupled circuits, he showed how a similar effect was being produced by many receivers, the operators of which were working their reaction too strongly. This gives rise to radiation of aether waves from the aerial circuit, which is picked up on other amateur and commercial aerials, resulting in interference. By means of the pendulum analogy the effect of tightly-coupled circuits and the necessity for the transmitter and receiver to be in tune, were well illustrated. The lecturer recommended the use of loose-coupled two-circuit receivers for reception of the short amateur wavelengths and broadcasting waves. He mentioned various means of tuning such circuits, and paid particular attention to the use of the variometer.

A lengthy discussion took place at the close of Mr. Yardley's remarks. A hearty vote of thanks was accorded to Mr. Yardley in the usual manner. The meeting terminated at 10 p.m.

The Hon. Secretary recommends W. H. Nottage's book on the "Calculation of Inductance and Capacity" (The Wireless Press, Ltd.), to those who desire to become more familiar with these all-important electrical properties that determine "tuning."

### Edinburgh and District Radio Society.*

Hon. Secretary and Treasurer, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

General Meeting held on May 12th, when six new members and two Associate Members were elected. This was followed by a sale of second-hand apparatus, which again proved very successful, a percentage of the amount realised going to the Apparatus Fund of the Society.

Shortly we hope to remove our headquarters to 117, George Street. Members will be notified of the definite date, and strangers or others who may wish to visit the Society on meeting nights should first communicate with the Hon. Secretary.

It has been decided to fix one evening per week for a "work" night, when certain definite experimental work will be undertaken by volunteers. The day and time will be fixed in due course.

Although our membership is increasing rapidly, we are still open to receive new members, as our new headquarters will be considerably larger and meetings will not be so overcrowded as they have been recently.

### Sunderland Wireless and Scientific Association.*

A General Meeting of the Association was held on Saturday, April 8th, at the Technical College, when Mr. Marcus G. Scroggie, of the Edinburgh and District Radio Society, gave a most interesting lecture on "Inductances." The lecture was illustrated by some interesting slides and demonstrations.

A General Meeting was held on Saturday, April 22nd, when Mr. A. F. Stafford gave an interesting lecture on "Aerial Design," which was followed by a brisk discussion. Mr. Stafford then gave a demonstration on his five-valve receiving set.

On Saturday, April 29th, under the auspices of the Association, Mr. T. Brown Thomson, of Messrs. Burndept, Ltd., gave a public lecture on Telephony, illustrated by a demonstration on an Ultra IV receiver.

On Thursday, May 11th, and Tuesday, May 16th, a number of members visited the Radio Communication Co's. offices at Newcastle-on-Tyne, where

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they were shown a ship's cabin fitted with ¼ and 1½ kilowatt sets.

The Association is now affiliated with the Wireless Society of London, and the present membership is 110.

Hon. Secretary, Mr. H. G. MacColl, 1, North Elms, Sunderland.

### The West London Wireless and Experimental Association.*

Club Rooms: Belmont Road Schools, Chiswick, W.4.

A meeting was held on Thursday evening, May 4th, when Mr. Oswald Carpenter, Associate I.R.E., gave an interesting lecture on "Short Wave Reception, and various Circuits in connection therewith." After two hours continuous speaking the lecturer finished at 10 p.m. Members and their friends turned up strongly and accorded the lecturer a very hearty vote of thanks for his "yarn," as he himself described it. After the lecture a large number of pictures were shown on the screen—photographs of various large stations, aerials, and apparatus which have been built or fitted throughout by the Marconi Scientific Instrument Co. A vote of thanks was also accorded the Company for the use of the slides.

Meeting held Thursday evening, May 11th.—Another very fine lecture and demonstration given by Mr. Edward McT. Reece, of Messrs. H. Butler & Co., on "Transformer Coupled H.F. Amplification." Great interest was shown in this lecture and the diagrams placed on a blackboard by the lecturer. As the result of the Great Fight at Olympia was to be broadcast by **2 LO** (Marconi House, Strand) Mr. Reece arranged his apparatus ready for the reception of the telephony that was to be sent out.

Owing to the Club's Brown's Relay being under repair we were unfortunate in not being able to use the loud speaker with any great success, and Mr. Reece kindly read aloud all the messages as they were received, and great excitement prevailed until the message that the first round was to start. Hardly had the words been repeated aloud when there was a hush, and the thrilling announcement "Carpentier has won" was made. The lecturer was accorded a very hearty vote of thanks for his detailed account of his subject, and the members left for home at 10.20 p.m.

Members are particularly requested to scan the Calendar of Current Events column each week.

The Secretary will have much pleasure in forwarding particulars of the objects of, and particulars respecting membership of the Association upon application from any gentleman interested in Radio Telephony, etc.

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushy Road, Harlington, Middlesex.

### Radio Experimental Association* (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

An interesting event in the history of this Association occurred on Thursday, May 11th, 1922, when we were very fortunate in securing Mr. Carpenter as lecturer on "Wireless during the War." The attendance exceeded all expectations, and it was a very gratifying result for those who worked hard to make the evening a success.

We were also very fortunate in having Mr. L. O. Trivett, J.P., our President, with us for the occasion.

In his remarks Mr. Trivett expressed the opinion that the amateur wireless movement was a great national asset. He was also very pleased, he said, to see the youth of to-day engaged in the very useful scientific research of radio telegraphy.

The lecturer had a very good collection of slides, some belonging to himself and others very kindly loaned by Major Stanley, and also the Marconi Company. Mr. Carpenter took us through from the beginning of the war when spark sets were the only ones in use, and when aerials had to be of considerable height and length in order to secure results, to the closing stages of the war when with the development of the thermionic valve, aerials were reduced to a minimum in order to obtain greater facility in transport. He also illustrated by means of slides the conditions under which the wireless work was carried out, and in his opinion he thought no service deserved greater praise than the Signal Section of the Royal Engineers. Mr. Carpenter also presented diagrams showing how power buzzer work was carried on, and also illustrated the use of listening sets. Unfortunately the time did not permit of too detailed an explanation of C.W. work, this Mr. Carpenter has promised for a later date.

In his concluding remarks the President voiced the opinion of the audience when he said that they were fortunate to have in the lecturer a member who evidently had a practical knowledge combined with ability in a marked degree to impart that knowledge to others. Mr. Carpenter put this down entirely to his long association with Major Stanley, the Chief Instructor on Wireless to the B.E.F. in France.

The meeting closed with hearty votes of thanks to the lecturer for his very interesting entertainment, to the Marconi Company and Major Stanley for the loan of some of the slides, and also to the President for officiating during the evening.

Full particulars of the above Association will be supplied on application to the Hon. Secretary.

### North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 91st meeting of the Club was held on Wednesday, May 17th, the Chair being taken by the President at 8.30 p.m. The minutes having been read, and some announcements having been made by the Secretary, the Chairman addressed the meeting, and more particularly those who were new members, or prospective new members. His remarks were as usual, witty and to the point, and members were pleased to see him back in his old form after his indisposition, which has kept him from taking an active part in the Club's affairs recently.

He then introduced to the meeting Mr. Ed. McT. Reece, who had kindly come down to lecture on "The Advantages of Sectional Wireless Sets."

Mr. Reece said that in addressing this Club, he was faced with the difficulty that although it was one of the oldest clubs, and had many advanced experimenters, yet he gathered from the Chairman's opening remarks that there were present that night a number of beginners. He therefore asked the advanced workers to forgive him if he went over ground which was already familiar to them.

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He said that his lecture would be like the set he had brought to the hall with him, viz., in sections. In the first place, he showed what advantages there were in being able to connect up the instruments in different ways. The instruments on the table were made by Messrs. Butler & Co. with that end in view, and the base-board was pierced with holes spaced equidistantly, and the instruments could be removed and refixed with the greatest ease, the holding-down screws being the terminals.

The next section dealt with the meanings of the terms "capacity" and "inductance," and Mr. Reece explained these in a very clear manner by diagrams on the board, and mechanical analogy. This explanation was of great interest to the beginners, and several new points were brought out which had not been clear before.

Mr. Reece said that he felt a certain regret that the coming of the valve had made such a revolution in Wireless that signals could be obtained even if the apparatus was carelessly made, whereas in the days of crystals all connections had to be good, and the adjustments accurate, and the general efficiency had to be high before signals could be heard. Nowadays, if the signals were not as loud as desired, there was a tendency to add more valves rather than to look for the real cause of the trouble. Personally, he said, he was very fond of crystals, and advocated using one crystal and one valve, particularly for beginners. This combination was both efficient and cheap.

The next section of the lecture was of a more advanced nature, and several questions were dealt with by Mr. Reece. Mr. Dixon had a lot to ask regarding grid leaks, and grid condensers, one of his favourite subjects, and ten o'clock came and members still had questions to put. At the close of question time, the Chairman thanked Mr. Reece in a few well-chosen words, and the applause which followed left no doubt as to the way in which the lecture had been received.

During the evening nine new members applied for election.

### Glasgow and District Radio Club.*

Hon. Secretary, Mr. Robert Carlisle, 40, Walton Street, Shawlands, Glasgow.

The increased attendance at recent meetings and a considerable influx of new members are gratifying indications of our progress in the world of wireless. The publicity which has been given recently to the scheme for broadcasting wireless telephone messages, outlined by the Postmaster-General, will lead many to study wireless work and stimulate their interest in the subject. The knowledge that one of the proposed transmitting stations will probably be located at Glasgow has caused no little excitement and enthusiasm among local amateur wireless men and the public generally. There is nothing that popularises wireless more than a concert by a famous singer. Glasgow is a musical community, if the Musical Festival recently held is any criterion, and the opportunity of enjoying first-class music in the comfort of one's own home, at no expense, should cause a very large increase of recruits to the ranks of radio amateurs in Glasgow and District. The novice in wireless matters reaps an advantage by becoming a member of a wireless club. He will meet others keen on the same work, and obtain the benefit of his fellow workers experiences and profit by his mistakes. This, at any rate, is the spirit that animates the Glasgow Club, and the reason we mention it is because it may not be realised by other radio enthusiasts who are plodding away by themselves, and not connected with any organisation devoted to the subject of their pastime.

At a recent meeting held in temporary premises at 11, Elmbank Street, we had a very fine lecture from Mr. A. F. Stevenson, on "Cable Engineering." It was fully explained how the various types and grades of cable were manufactured and tested. Mr. Stevenson exhibited numerous samples of the cable about which he lectured, and made clear the intricate processes involved in the making of each kind. Mr. Stevenson held the attention of his audience throughout, and after answering some questions, at the close he was accorded a hearty vote of thanks for his instructive and interesting lecture.

At the two last meetings held we had a lecture on "Capacity and Inductance," from Mr. A. McLennan. The lecturer divided his subject into two parts and gave one at each meeting. With the aid of blackboard diagrams and some figures in simple arithmatic Mr. McLennan made the subject clear to those members of the audience who had only a very elementary knowledge of electricity. Some clever analogies were introduced, but the outstanding feature was the particulars given with Part 2 of the lecture of how to make sets capable of receiving waves from 200 to 20,000 metres. The details given included dimensions of formers, gauge of wire, capacity of condensers, etc. The information imparted to members in this respect was such as could not be gained by a perusal of many volumes of technical literature on Wireless work, and was therefore of a more or less exclusive nature. Mr. McLennan appeared to have devoted much time to the numerous calculations involved in the preparation of such a wealth of detail. To our personal knowledge he is a rather busy man, and we are just afraid he must have encroached upon his usual hours for sleep. The lecturer then answered a number of questions, after which he was accorded a very hearty vote of thanks.

Owing to the removal of the N.B. Wireless Schools to another address, the Club has had to look for new premises. We enjoyed the hospitality of the Wireless Schools at 206, Bath Street, and a long period, where everything possible was done for our assistance and comfort, and at a recent meeting they were, through Mr. W. K. Dewar their representative, thanked for their kindness to the Club.

A sub-Committee, consisting of Mr. A. Pick and Mr. A. Hood was appointed to look out for new premises, and after much trouble these have been found at 200, Buchanan Street, where the Club meetings will be held, commencing in October. During next session meetings will be held weekly, on Thursday nights, and the Hon. Secretary will be pleased to have the names of any gentlemen who are willing to give a paper on wireless or allied subjects, during the coming winter.

The following sub-Committee has been appointed for renovating the Club's receiving gear.—

Mr. D. B. Wright (convener), Mr. D. J. Carmichael W. G. Corner, J. R. McCulloch, A. Pick.

Intending members should apply to the Hon.

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Secretary, who will give all required information. The annual subscription is 10s., with an entry fee of 5s.

### The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

On Thursday, May 18th, some members entertained their colleagues with descriptions of their sets.

Many interesting points were raised and discussed, and numerous difficulties encountered by members were explained.

Mr. Martin gave a short discourse on the construction of a four-valve set.

Several new members were elected, and three proposed as members.

General business followed, the meeting closed after a most enjoyable evening. Intending members should write to the Hon. Secretary as above.

### Bristol and District Wireless Association.*

Hon. Secretary, Mr. E. C. Atkinson, 5, Pembroke Vale, Clifton.

The Annual General Meeting was held on December 16th, 1921, the following Committee being elected: Professor A. Tyndall (President), Mr. G. Marcuse (Chairman), Rev. H. W. Jukes (Hon. Treasurer), Mr. E. C. Atkinson (Hon. Secretary), Mr. A. E. Mitchell and Mr. L. F. White. Mr. A. C. Davis and Capt. C. Thomas were appointed Auditors.

Between January and April, 1922, ten new-comers have brought the membership above the 50 line.

Other meetings have been held: on January 20th, February 24th, March 31st and April 28th. In addition to buzzer practice and general conversation, proceedings have included the following items: "The Ultra-Micrometer," by Mr. W. Sucksmith; "Resistance in Wireless Circuits," by Mr. L. W. J. Silcocks; "A Home-made Receiving Set," by Mr. J. S. Hobbs; "A Self-contained Portable Receiver," by Mr. L. F. White; "High-frequency Experiments," by Mr. A. E. Siddons-Wilson, and "Short Wave Oscillations (Wavelength Measurement and Meter Calibration)," by Mr. H. E. George.

Much to the regret of the Association, the Chairman (Mr. G. Marcuse) has migrated to London. Recently he supplied the wire for a new aerial at the University. His enthusiasm and his telephony will be missed by many.

### Richmond and Kew Wireless Society.

A meeting of the above Society was held on Thursday, May 11th, with Mr. W. H. Lloyd (President) in the chair.

Mr. G. G. Blake, A.M.I.E.E., A.Inst.P., delivered a most excellent lecture on the "Working of Modern Wireless Apparatus." The lecturer commenced with the elementary principles of atomic theory, leading on to the nature of electrons and their functions in connection with the three-electrode valve.

Mr. Blake, who had kindly brought along a splendid assortment of apparatus, demonstrated throughout the lecture. The experiments with the electroscope and those demonstrating some of the properties of the ultra-violet rays being particularly interesting. With the aid of lantern slides he then explained the characteristic curves of the valve at varying grid voltages; diagrams of receiving and transmitting circuits; and passed round for inspection a very neat, compact and efficient receiving set.

Later Mr. F. Hope-Jones (Chairman of the Wireless Society of London), who was present, demonstrated with slides the motion of wave trains of wireless waves, which was very interesting. Mr. Hope-Jones wished the Society every success in its objects, and proposed a vote of thanks to the lecturer. The President, in seconding Mr. Hope-Jones, expressed his thanks on behalf of the Society to Mr. Blake for his very interesting lecture, and demonstrations.

During the lecture an operator was on duty to "listen in" for the result of the Carpentier-Lewis fight.

The meeting adjourned at 10.30 p.m.

Hon. Secretary, Mr. A. J. Richardson, 14, Forest Road, Kew.

### Ilford and District Radio Society.

The Society departed somewhat from its customary programme on Thursday, May 11th, when Mr. H. B. Adams, F.R.A.S., late of Greenwich Observatory, honoured us with a lecture on "Astronomy."

Mr. Adams brought with him a large number of lantern slides, and led us with great clarity through a maze of star clusters, sun spots, eclipses and the like, backed up with figures and statistics, the enormity of which made the hearer gasp, until we began to realise what a tiny, insignificant spot is our own earth. His description of the light rays and of their minute wavelengths was particularly good.

Many of us, with thoughts of the new spring hat now on its way to America, moaned in sympathy when Mr. Adams deplored the fact that owing to financial stringency Great Britain was far behind America in astronomy, especially as regards the size of the telescope available for observation purposes. The lecture closed with a brief but none the less lucid description of the method employed at Greenwich for observing and recording correct time.

### The Grimsby and District Radio Society.

At a meeting of the above Society, held on May 16th, it was decided owing to the greatly increased membership that the present clubroom and the room adjoining be combined as one, assuring greater accommodation for its members, who are at great advantage being able to gain access on any and at any time in the day.

It was also intimated that a public lecture will be given at an early date by Mr. I. Brown Thompson, of Messrs. Burnham & Co., on "Telephony" in the showrooms, kindly lent by The Lincolnshire Motor & Electric Traction Co.

Two very interesting lectures were given during the last month, which were:—April 4th, "A Three-Valve L.F. Amplifier for All Waves," by the President, Mr. C. Hewins, who demonstrated one of his own construction, it giving quite excellent results. April 25th, "American Amateur Sending Stations for the Transatlantic Tests," by Mr. P. H. Shephard (Chairman); and on May 9th, "Resistance Capacity Amplifiers," by Mr. Garthwaite (Treasurer). Some very interesting points were gained by the discussion following.

Hon. Secretary, Mr. J. H. Perkins, 35, Hare Street, Grimsby.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only : Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"W.D." (Huddersfield)** *asks (1) For diagram of four-valve receiver for frame aerial. (2) What must be the capacity of accumulators to supply filament current for four valves. (3) If necessary to have transformers between all the valves.*

(1) For this purpose it will be advisable to have two H.F., one rectifier and one L.F. valve, used with a 4′ or 6′ frame aerial. For a suitable diagram *see* Fig. 1. (2) Four valves will require 3 amperes total filament current. It will be necessary to use a 6-volt 30 or 40 ampere hour accumulator. (3) It is essential to have some method of coupling between the valves. Transformers are better on short wavelengths, while resistance capacity coupling may be used for long waves.

**"P.O." (Aber)** *asks (1) For criticism of two-valve diagram. (2) If he should hear* **2MT** *Concert on small aerial. (3) What coils do we recommend. (4) If 15-volt valves may be used.*

(1) This circuit is quite O.K. as a rectifier and one L.F. combination, but is not sufficiently sensitive for **2MT**. The "R" valves will require 6-volt filament battery as a resistance is used. There should be a small fixed condenser across the telephones. Crackling noises are probably due to bad connections. (2) The aerial is on the small side, and for it to be of any use the strands should be more than 1′ apart. (3) For a commencement single-layer coils should be used. Your slab coils may be suitable, but you do not give any particulars of them. (4) If these valves with 15 volts H.T. give good magnification, they are quite all right to use, but we do not know of any such valves at present.

**"ARIEL" (Reigate)** *asks (1) which of two single-valve circuit arrangements is the more useful. (2) If vulcanite is as good an insulator as ebonite. (3) Whether* **PCGG** *will be heard on either of above arrangements.*

(1) The second arrangement, with tuned reaction coil, will be the most efficient, but is more difficult to handle until one is used to it. (2) Vulcanite is an elastic term often misapplied to ebonite. For receiver panels it is just as effective as ebonite. (3) With arrangement No. 2 you may hear it, but it will not be very strong.

**"T.G." (Tamworth)** *is making a set for 180 to 30,000 metres, and asks (1) If honeycomb coils joined in series by a switch for cutting off dead-ends are as effective as coils plugged in singly.*

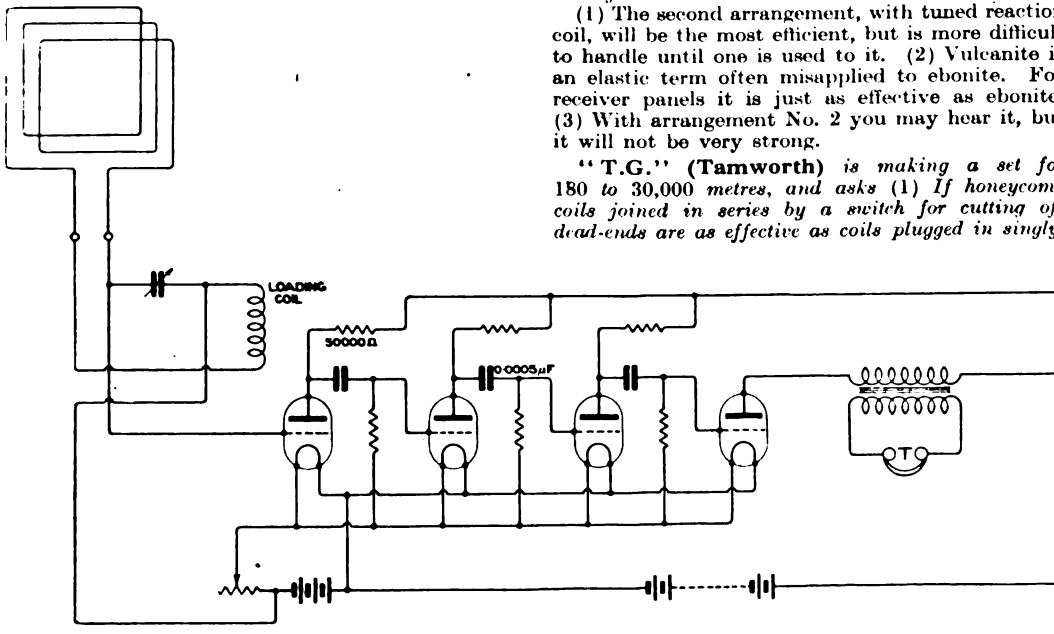


*Fig. 1.*

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(2) *Whether a* 0·0015 *mfd., or* 0·0005 *mfd., series-parallel A.T.C. is most efficient.*

(1) On wavelengths above about 2,000 metres either method may be used, but for wavelengths below this idle coils should not be placed near the coil in use. (2) On short waves the 0·0005 mfd. condenser will give better tuning in series with the A.T.I., while for long waves the larger condenser in parallel with the A.T.I. is better.

"**BEGINNER**" (**Chester**) *wishes to make a simple single-valve set with certain apparatus, and asks* (1) *What additional apparatus will be required.* (2) *Type of valve to use.* (3) *For diagram of suitable circuit.* (4) *Range of set and if suitable for telephony.*

(1) You will be well advised to make a single-valve reaction set, for which the following additional apparatus will be required: reaction coil (to slide in and out of A.T.I.), one valve, 6-volt battery, filament resistance (5 ohms), H.T. battery (30 to 50 volts), grid condenser (0·0003 mfd.) and leak (2 megohms), and telephone transformer. The size of reaction coil cannot be given without knowing the size of A.T.I. (2) "Ora" or "R" valve. (3) The apparatus should be connected as shown in Fig. 3, page 90. The aerial and earth should be joined across the grid inductance, and not as shown. (4) We cannot estimate wavelength range, and therefore do not know from how far the set will receive. You will probably not hear much telephony owing to your situation.

"**ANCHOR-GAP**" (**Hornsey**) *asks* (1) *For the capacity of a given condenser.* (2) *The wavelength range of his tuning coil, which is* 6" *long and* 3½" *in diameter, and wound with No.* 22 *S.W.G.* (3) *Whether his variable condenser is suitable for fine tuning.* (4) *Whether a given crystal circuit is suitable for the reception of near-by telephony.*

(1) Impossible to say, without knowing thickness of plates, but if of No. 20 gauge the value would be about 0·0002 mfd. (2) Range without parallel condenser up to 900 metres. (3) Yes. (4) Yes, but it is doubtful whether the station will prove to be sufficiently strong unless, of course, it is very near.

"**L.H.I.**" (**Leicester**) *asks* (1) *If any other type of vernier condenser is suitable for use with the pocket receiver, described on page* 747, *March* 4*th issue.* (2) *If a single wire aerial,* 20′ *high and* 140′ *long, is suitable.* (3) *What to use for an earth where there is no water-pipe.* (4) *Whether the set can be used for the recepion of* FL, 2MT *and* PCGG.

(1) Any moving plate air dielectric condenser having capacity up to 0·0005 mfd. may be used with the set. (2) Fairly good, provided there is not too much sag. (3) Bury a piece of fairly heavy copper wire beneath your aerial and running the full length of it, or, if you can, dig into damp soil and bury an old galvanised iron bath or dustbin surrounded with fine coke. Make sure that you have a good connection to this buried conductor. (4) You should get FL easily, and possibly 2MT, but for PCGG it is advisable to add one H.F. or L.F. amplifier.

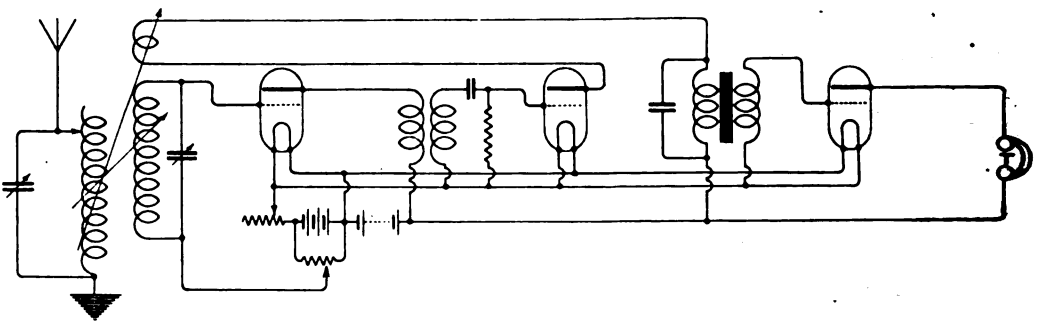

*Fig.* 2.

"**FREQUENCY**" (**Southampton**) *asks* (1) *How many turns of No.* 36 *to wind an eight-groove ormer for a* 300 *to* 3,000 *metre transformer.* (2) *If method shown of connecting the transformer between the two valves is correct.*

(1) This type of transformer is not very suitable for such short wavelengths as 300 metres. For 300 to 1,000 metres, transformers in the form of single-layer windings should be used. If each groove is filled with wire the resultant wavelength would probably be between 2,000 to 3,000 metres. (2) This is correct.

"**FLUX**" (**Clerkenwell**) *is using C Mark III tuner and German L.F. amplifier, and asks* (1) *Whether to use a transformer between crystal telephone terminals and amplifier input terminals.* (2) *Referring to circuits, page* 529, *November* 26*th issue, asks if reaction coil may be taken from primary instead of secondary.* (3) *When using circuit* 2 *with German amplifier if the coupling transformer should be used.* (4) *For diagram to add additional H.F. valve to circuit* 2.

(1) We do not think it advisable. Signals with crystal and L.F. mag. should be weaker than those given by a valve and L.F. mag. (2) The reaction coil should be connected as shown in the diagram referred to. (3) The German amplifier should be inspected to see if it has a transformer in the circuit of first grid. If there is one, there is no necessity to use an external transformer. (4) These circuits were recommended for telephony, and we therefore advise a transformer coupled valve, diagram of which is given. (Fig. 2.)

"**A. McD**" (**Edinburgh**) *asks* (1) *For a diagram of a* 3*-valve set for reception of* PCGG. (2) *For dimensions of a loose coupler suitable for wavelengths of* 300 *to* 5,000 *metres.* (3) *Whether*

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*a stranded wire aerial will give better results than his present aerial of No. 16 copper for reception.*

(1) *See* Fig. 1, page 37, April 8th issue, but use A.T.C. at smaller value and connect it in series in the aerial circuit. (2) Aerial circuit 8" of windings of No. 28 D.C.C. on a 6" former, 19 tappings, making the final ones step over bigger portions than those at the beginning. Secondary (or reaction) circuit, 4" of winding of No. 32 S.S.C. on a 4½" former with four tappings at ½", 1", 2" and end. (3) Very little would be gained.

**"2.59" (Burnham-on-Sea).**—(1) Your circuit is quite correct. It is better to put the A.T.C. across the entire inductance in the aerial circuit. (2) The values would appear to be correct, excepting, perhaps, the grid condenser, which is a little low, but the value is best determined by the results it gives. (3) The only improvement that can be suggested is that you provide a double pole two-position switch to connect A.T.I. in series or parallel in the aerial circuit.

**"H.J.B." (Derby)** *asks for a diagram of a 4-valve set suitable for reception of telephony, with particulars as to gauges of wire and dimensions of inductances.*

See paper read by Mr. Campbell Swinton before the Wireless Society of London, which appears in the issue of June 25th, 1921. As a beginner we would recommend you to commence with simple single valve circuits. The instrument described on page 202 of the issue referred to is quite good for the reception of 1,000 metre telephony.

**"C.R.S." (Colombo)** *wishes to know* (1) *Which is the best theoretical ratio of inductances for use in aerial and reaction circuits.* (2) *Whether it is better to use a separate reaction unit.* (3) *Inductance values of secondary coils in reaction unit.* (4) *Whether statement made on page 724 of the issue of February 18th, with regard to the efficiency of the circuit given in Fig. 2 on wavelengths over 7,000 metres, is correct.*

(1) It is impossible to state definitely the best combinations of inductance values from a theoretical point of view. One might deduce that certain arrangements will give better results, but experimenting is the best guide. Generally speaking, the arrangement that provides for loosest coupling of reaction or secondary circuit is the most efficient. (2) We presume you mean the use of a separate heterodyne, the merits of which have been discussed from time to time in this journal. The advisability of adopting such an arrangement depends entirely upon the signals it is intended to receive. If separate heterodyne is used it is advisable to leave in your receiving circuit some feed-back arrangement, such as inductive or capacity reaction. Ratios between anode and secondary coils cannot be definitely stated, but as a general rule should be approximately equal. (4) Articles that appear in this journal must be taken as expressing only the opinion of the author, and we cannot undertake to criticise the merits of circuits given in replies in these columns. The height of the curve in Fig. 3, page 724, must not be regarded as a direct factor of efficiency, but more as a measure of advice in adopting circuits for particular wavelengths. The circuit is not the popular one, as you will see that tuning is effected by stepping out a portion of the coil and short circuiting it, a practice that is often adopted for tuning to short wavelengths.

**"E.R.N." (Accrington)** *asks* (1) *If circuit Fig. 8, page 100, April 22nd issue, is suitable for the reception of spark, C.W. and telephony.* (2) *Windings for inductances* L1, L2 *and* L3 *and capacities of* C1, C2, C3 *and* C4 *for* 4,000 *metres.* (3) *Which is better, H.F. or L.F. amplification.*

(1) Yes. (2) L1 and L2 to be each of 4" of winding of No. 26 S.S.C. on 6" formers; L3, 3½" of winding of No. 34 S.S.C. on 4½" former; C1, 0·0003 mfd.; C2, 0·002 mfd.; A.T.C. maximum, 0·0015 mfd.

**"H.H." (S.W.1)** *asks* (1) *If it is possible to amplify the Dutch Concert to such an extent that it can be heard 50 ft. from the loud speaker.* (2) *For a suitable circuit for this purpose.*

(1) We do not recommend you to attempt this with **PCGG**, although it might be successfully accomplished with **2MT** or any other high-power British broadcasts. (2) Use the circuit shown in Fig. 1, page 199, issue of June 25th, 1921. You may omit condensers C2, C3 and C4 and make transformers of precise values to suit wavelength, which are best found by experiment.

**"G.G.F." (Newcastle-on-Tyne)** *asks* (1) *For dimensions of plates for making* 0·001 *mfd. fixed condenser.* (2) *Wire for step-down telephone transformer.* (3) *If it is possible to employ an H.F. transformer for* 300 *to* 30,000 *metres with switch and condenser.* (4) *Windings for L.F. transformers.*

(1) Use seven tinfoil strips with overlap ⅛" × 1" and six pieces of mica dielectric 0·002" thick. (2) 1¼ ozs. No. 44 S.S.C. for primary and 1 oz. No. 36 for secondary. (3) No. Use H.F. transformer coupling by means of intervalve coils for wavelengths up to 1,500 metres. Beyond this range use capacity coupling. See article page 133, issue of April 29th. (4) See page 52, issue of May 28th, 1921.

**"F.D.P." (Stourport)** *asks* (1) *For diagram of wavemeter for wavelengths* 180 *to* 2,000 *metres.* (2) *Constructional details for same.*

(1) and (2) See issue of October 15th, page 444, and October 29th, page 461, and November 12th, 1921, page 493. The approximate windings can be obtained from the latter article, but the actual windings must be found by calibration with a standard wavemeter. See also May 6th issue, page 161.

**"D.C.M." (Southsea)** *submits circuit and asks* (1) *Why his valve howls.* (2) *What additional apparatus is required for reception of* **PCGG** *and* **2MT.** (3) *For a revised diagram of connection with additions.*

(1) Your aerial inductance is bridged with two variable condensers. We presume that one is a vernier for fine tuning. Omit the leads between L.T. minus and bridge No. 3. A condenser of 0·002 mfds. must be permanently connected across terminals marked 1 and 2 (telephones or "input"). Try altering the value of your grid leak. (2) and (3) No additional apparatus should be required for the reception of either of these stations. The circuit comprises one detector valve with reaction and two note magnifier valves and a revised system of connections is not necessary.

**"M.J.L." (Belfast)** *asks* (1) *For particulars of honeycomb coils to tune from* 350 *to* 30,000 *metres* (2) *The connection of these inductances to a 3-valve amplifier.* (3) *For seven-way switch connections.* (*This question is not quite understood*). (4) *Whether*

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*slab inductances instead of honeycomb coils would give the same results and take less space.*

(1) Make 4½" in diameter, 1¾" hole and wind with No. 26 D.S.C. wire. This will give you approximately 55 turns per coil. Space the coils about ¼" apart, and you will require about 30 such coils in your aerial circuit to tune to 30,000 metres. Arrange several switches to avoid dead-end effect and to bring in various numbers of coils. You might make one slightly smaller for use alone on 300 metres. Use a similar bunch of coils for closed or reaction circuit, bringing one coil of each circuit near together for the purpose of providing coupling. (2) Connect aerial coils to grid and L.T. minus of the first valve, and connect reaction coils in the plate circuit. If your amplifier is L.F. use grid condenser and leak in the lead from the inductance to the grid and bridge primary of first transformer with a condenser value 0·002. (4) Honeycomb coils are preferable to slab inductances.

**"G.T." (East Keswick)** *asks for criticism of circuits.*

All of the circuits given would appear to be quite in order, but we would recommend you, if you can, to carefully test your resistances as to correctness of value by means of a delicate galvanometer and H.T. battery. Complications and stray capacity effects may be due to the fact that your H.T. is derived from your house mains. We presume that your apparatus possesses good insulation. As you only use one amplifier valve you would be well advised to make it a note magnifier.

**"B.D." (Mill Hill)** *asks* (1) *If crystal set diagram is correct and for capacity of blocking condenser.* (2) *If telephony will be heard.* (3) *What is the lowest resistance of telephones which may be used.* (4) *If an ordinary telephone receiver with a transformer is any good.*

(1) To make this set effective a small variable condenser should be connected across inductance, as shown in Fig. 3, page 60, April 8th issue. The telephone condenser should be 0·001 mfd. (2) You might hear Croydon telephony, but no other. If the wavelength range is suitable, ship stations and **FL** should be received. (3) and (4) For crystal sets high resistance 2,000 to 8,000 ohms telephones should always be used if possible. An ordinary telephone receiver with transformer would not be very efficient.

**"D.G.B." (Putney)** *asks* (1) *If telephone transformer must be used with* 120 *ohm telephones in a single valve set.* (2) *If variable condenser is correctly connected.*

(1) Yes. (2) This is a very inefficient circuit, as the idle sections of both inductances are short circuited; no reaction coil is used, and no telephone blocking condenser. Add a reaction coil and grid to condenser and leak, as shown in Fig. 3, page 90, April 15th issue.

**"FORM 5 B" (Lancashire)** *asks* (1) *For single valve capacity reaction high-frequency amplifier diagram to attach to rectifier panel.* (2) *Names of stations.* (3) *Why receiver circuit is noisy on* 2,600 *metres only.*

(1) This is rather vague. An effective capacity reaction cannot be used with the one valve only. Use a magnetic reaction connected to the terminals marked in your diagram. To add an additional valve, see Fig. 3 for connections. (2) Many of the calls are to be found in the "Year-Book of Wireless Telegraphy." (3) It is probable that the condenser is short circuited at the point which 2,600 metres is tuned. There is no other reason for it being noisy on only one wavelength.

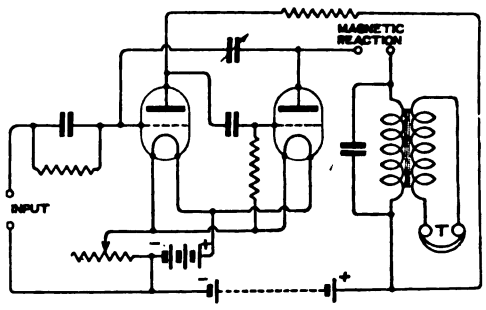


*Fig.* 3.

**"H.R.N." (Ealing)** *asks* (1) *For diagrams of two-valve L.F. amplifier to use with existing two-valve set.* (2) *If his* 8,000 *ohm telephones may be used in L.F. set.* (3) *If loud speakers magnify signals through acoustic properties of the horn.*

(1) and (2) The diagram given in reply to **"I.D.A." (Wellington)** may be adapted for your purpose. The 8,000 ohm telephones may be used in place of the telephone transformer shown. If two terminals are joined in series with the primary of the first transformer the telephones may be inserted there when it is not desired to use the note magnifier and terminals shorted by a link when it is used. (3) The signals are intensified by the horn, but they must be strong in the first instance.

**"W.H.W." (Cardiff)** *asks* (1) *To which side of L.T. battery the H.T. should be connected.* (2) *Why valve "howls" while set is reacting.* (3) *Why reaction coil must be reversed when the H.F. magnetic valve is cut out.*

(1) It is immaterial to which side it is connected. It is wrong to reverse the L.T. battery to test this, because you make the grid positive and come almost to the saturation point on the curve and stop the set working. (2) It is difficult to say the cause, as you appear to have made all the changes possible. It is probably due to a faulty reaction coil. (3) This is unavoidable, because changing the number of valves alters the sign of this current in the reaction coil. To overcome this it is necessary to have a spherical reaction coil which can be turned through 180 degrees.

**"PADLOW" (Bradford)** *asks* (1) *If Fig.* 5, *page* 813, *March* 18*th issue, is suitable for use with* 600 *metre H.F. transformers.* (2) *No results received on above set, using a* 6′ *frame aerial with single slab inductances.* (3) *How to employ coils to obtain satisfactory results.* (4) *If a diagram given is correct.*

(1) Yes, if the tuning circuit is correct. (2) For 600 metre reception a 6′ frame should be wound with about ten turns if a 0·001 mfd. tuning condenser is used. No loading coils are necessary. (3) and (4) The slab coils may be usefully employed connected as shown in your diagram. You omit to show the 0·001 mfd. condenser, which should be connected across the telephones. The reaction slab should be placed on top of the A.T.I. slab and, if necessary, turned over to make the set oscillate.

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**"MEREDITH" (Merioneth)** *asks* (1) *Why his single valve set does not receive telephony.* (2) *Windings for* 1,200 *metre tuner.* (3) *Why his set does not oscillate under* 1,000 *metres.* (4) *If a circuit consisting of primary, secondary and reaction is necessary for telephony.*

(1) Your set is not sufficiently sensitive for telephony. You will require to add at least two more valves. Even then it is doubtful if you will hear any, as you are situated in a distant part of the country. (2) This may be a 4"×4" A.T.I. wound fully with No. 26, and a 3"×4" reaction coil wound full of No. 30. The aerial condenser and inductance should be in series. (3) It will not oscillate because with the present winding and arrangement of circuit the minimum wavelength is above 1,000 metres. For short waves the A.T.I. and A.T.C. should be in series. No. 30 wire is too fine for aerial circuits. (4) It is not essential to have this arrangement, but the circuit is more selective, therefore the tuning-in of stations is more difficult. Your diagram shows a resistance in the grid circuit but no condenser. There should be a small capacity fixed condenser across this resistance, otherwise it is of no use.

**"R.T.H." (Winkleigh)** *asks* (1) *For criticism of three-valve circuit.* (2) *Why it will not work on wavelengths longer than* 8,000 *metres* (3) *How to add another H.F. valve.* (4) *If possible for an amateur to make a loud speaker.*

(1) The circuit is O.K., except that there should be a 0·001 mfd. condenser across the transformer winding in series with the reaction coil. (2) Probably because there is not sufficient inductance in your tuning coils to go beyond this wavelength. You give no details. (3) The diagram given to **"SIRIUS" (Brighton),** will show how this may be done. (4) It is possible, but we have no detailed information to refer you to other than articles in the February 19th, July 9th and August 20th issues of this journal.

**"D.A.B." (Birmingham)** *asks* (1) *For a diagram to add one H.F. and one L.F. valve to a circuit consisting of one rectifying and one L.F. valve.* (2) *If South African wireless telegraph regulations are similar to those existing in England.*

(1) *See* circuit given to **"B.D." (Leeds).** (2) We have no definite information, except that many private experimental stations exist in that country.

**"H.W.P." (Cumberland)** *asks* (1) *If a small dry battery may be used for filament lighting.* (2) *Which is the best all-round valve.* (3) *If* **FL** *telephony should be heard in Cumberland on a single valve set* (4) *Are there many ships using C.W.*

(1) No. Most of the ordinary dry cells would not stand the discharge current of about 3/4 amperes. In any case, it would be a wasteful method. However, specially designed valves passing low filament current may be operated from dry cells. (2) Either of the valves you mention are good. (3) With a well-designed set an experienced man might be able to make it just audible, but for good telephony about three valves will be required. (4) There are a good many ships now using C.W., their wavelength being 2,200 metres.

**"2 R.J." (Maidstone)** *asks* (1) *Why Dutch Concert is not received on a five-valve set, on which* **2MT** *and* 1,000 *metre amateurs are strong.* (2) *If set may be used for recording with a relay.* (3) *How to connect a* 1,000 *ohm G.P.O. relay in the circuit.*

(1) The set is not sufficiently sensitive for weak stations, as arranged. The reaction coil should be connected in the anode circuit of the third (rectifier) valve, and not in anode of the second note magnifying valve. There should be a 0·001 mfd. condenser across the rectifier anode winding. We do not like A.T.I. and A.T.C. in parallel for short waves. The billi condenser is wrongly connected for capacity reaction. Connect it from third anode to the first grid. (2) It might work for very strong stations used in conjunction with a Morse inker. (3) It might be connected directly in the anode circuit of the last note magnifier for a trial, but probably will be better if a step-down transformer, having a secondary of 1,000 ohms, were used.

**"R.K." (Bristol).**—You will probably find it difficult to eliminate the noises due to induction from the tramway wires. If the aerial is run at right angles it may reduce it. The use of low frequency magnifiers under such conditions will make matters worse, as the interference will then be caused by direct induction.

**"INTERESTED" (Enfield)** *refers to three-valve set, March* 18*th issue, and asks* (1) *If "R" valves can be used.* (2) *Are interchangeable transformers now on the market suitable.* (3) *For capacities of condenser C and C*1.

(1) and (2) Yes. They may be used if desired, and will necessitate a slight rearrangement of the apparatus mounted on the panel. "C" might be 0·0002 mfd. fixed, and "C1" a 0·0005 mfd. variable condenser.

**"J.S." (Seacombe)** *has a* 350 *to* 1,000 *metre single-valve set which will not oscillate when A.T.C. is shorted.*

The diagram given shows a variable condenser always across the whole of the A.T.I. This limits the minimum wave of the set. There should be a second slider on the A.T.I. An additional condenser in the aerial circuit will not reduce the wavelength to 180 metres. It will probably be necessary to have a separate A.T.I., but as no details of existing one are given we cannot say definitely.

**"RADIO MORSE" (Bow)** *asks* (1) *Where to obtain gramophone records for Morse instruction.* (2) *Winding on* 5" *diameter former for* 200 *to* 3,000 *metres.* (3) *Reaction coil for same.* (4) *Tuning coil and reaction for* 100 *to* 600 *metres.*

(1) The Gramophone Co., Ltd., Hayes, Middlesex. (2) If coil is wound with No. 22 wire as desired it must be 20" long, assuming that there is no tuning condenser in parallel. It will not be very useful below 400 metres. (3) This might be 4"×10" of No. 26. (4) Tuning coil 4"×4" of No. 22, reaction coil 4"×3" of No. 26.

**"R.C.B." (Cooden Beach)** *describes two-valve H.F. magnifier set with tuned reaction and crystal detector, and asks* (1) *What results could be obtained by substituting grid condenser and leak for rectification.* (2) *Whether apparatus can be arranged in a more efficient manner.* (3) *Best way to add another valve.* (4) *Criticism of results obtained.*

(1) We do not think there would be a great improvement in the results obtained, but think it worth trying. (2) To change from present plain aerial arrangement to a coupled circuit tuner would greatly increase the selectivity, otherwise this is quite a normal two-valve set. (3) Add another valve as L.F. magnifier. (4) Results are good, but Lympne should be as strong as Croydon.

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**"DOUBLE C" (Bury)** *asks* (1) *For single-valve diagram to utilise certain apparatus.* (2) *Wave-length range with existing formers.* (3) *What additions are necessary to increase range to* 30,000 *metres.* (4) *Maximum range for telephony.*

(1) and (4) A good circuit is given in Fig. 4, page 706, February 4th issue. This shows an additional valve as note magnifier, which may be put in or out of circuit as desired. You will find the second valve very useful for telephony, as you are a considerable distance away from existing telephone station. With additional valve you should hear **2MT** easily. (2) With the aerial condenser and inductance in series the maximum wavelength is 1,400 metres, and 3,000 metres with A.T.I. and A.T.C. in parallel. (3) To increase the range additional inductance in the form of slab or honeycomb coils will be required. These may now be purchased from advertisers almost as cheaply as they can be made. About 10 coils will be required to cover the range.

**"B.E.A." (Folkestone)** *asks* (1) *For dimensions for a variometer to tune to* 700 *to* 6,400 *metres with a* 0·0001 *mfd. fixed condenser across it.* (2) *Particulars of a frame for lid of box to receive* 500 *to* 1,500 *metres with* 0·0016 *mfd. condenser.* (3) *For reaction coil for same.*

(1) This is not a practical proposition, because a variometer to give such a great inductance change cannot be made. A variable condenser with tappings on plain winding is more straightforward. (2) Make a former to fit inside the lid and wind it with 40 turns of No. 26 wire. (3) The reaction coil former should be made to just fit inside the frame and should be pivoted on one end so that its position with reference to fixed coil may be varied. A suitable winding for 1,500 metres should be 60 turns of No. 30.

**"P.J.W." (Port Said)** *asks* (1) *Which is the better circuit to use for a* 3,000 *C.W. metre receiver, Fig.* 3 *or Fig.* 5, *February 4th, Q. and A. columns.* (2) *Particulars of honeycomb coils for tuning to this wavelength with a* 0·0007 *mfd. condenser and P.M.G. aerial.* (3) *Particulars of intervalve transformer for* 3,000 *metres.*

(1) We think Fig. 5 is the more reliable circuit to use for C.W. reception on this wavelength. (2) To give this wave range about five coils, which may be used for A.T.I. and reaction, should be made. They might be honeycomb or slab coils, 2" diameter, wound with No. 24 or No. 26 wire to 150, 200, 250, 300 or 350 turns. (3) Exact windings for H.F. transformers cannot be given. Probably the ordinary 8-groove former about 2" diameter will be found suitable if all the slots are wound full with No. 44 S.S.C. wire.

**"E.T.M." (Wimbledon)** *asks* (1) *For constructional details of chokes in transmitting circuit, Fig.* 1, *page* 774, *March 4th issue.* (2) *Constructional details of power and filament transformer.*

(1) For the iron core choke the secondary of an old ignition coil may be used. Its inductance value is not particular, provided it is greater than about 5 henries. The air core choke is for the purpose of keeping the H.F. currents out of the control valve circuit. The best value will depend upon wavelength and type of valve used, and must be determined experimentally. A 3" diameter coil, wound with 3" of No. 36 D.W.S., will be suitable as a trial coil. The feed condenser may be 0·001 mfd. and should withstand a 2,500 volt pressure test. (2) The design of power transformers is beyond the scope of these columns. Consult a book on Transformer Design, such as "Small Single-phase Transformers," by Edgar T. Painton (*Isaac Pitman*).

**"J. G." (Edinburgh)** *asks* (1) *For wavelength range of a basket coil with a* 0·001 *mfd. condenser.* (2) *If method of calculation given is correct.*

(1) The inductances of this coil is approximately 340 microhenries, and the wavelength is therefore 1,100 metres. (2) Your calculation is incorrect and you omit the Nagaoka constant K. Consult Nottage's Handbook or "Radio Measurements." The correct calculation is :—

$$L = \pi^2 d^2 n^2 e K$$

where

$D = 8$ cms.
$n = 18$ turns per cm. (No. 24 enamelled)
$e = 35$ cms.

$K$ for ratio $\frac{d}{e} = \frac{8}{3 \cdot 5} = \cdot 49$

$$L = \pi^2 \times 8^2 \times 18^2 \times 3 \cdot 5 \times \cdot 49$$
$$= 69500 \times 0 \cdot 49 \text{ cms.}$$

or $695 \times 0 \cdot 49$ microhenries, from which $L = 340$ mhys.

$$\lambda = 1885 \sqrt{LC}$$
$$= 1885 \sqrt{340 \times 001}$$
$$= 1885 \times \cdot 583$$

which is 1,100 metres.

**"A.C." (Yorkshire)** *describes a single-valve set and asks* (1) *For capacities of condensers.* (2) *Why set does not work on wavelengths lower than* 1,000 *metres.*

(1) You omit the most important dimensions of the variable condenser, *i.e.*, the distance between fixed and moving vanes. Assuming them to be $\frac{1}{10}$", the capacities are 31 plates, 0·0007 mfd. ; 13 plates, 0·00015 mfd. If the spacing is $\frac{1}{8}$" the capacities will be half the above values, or double values if only $\frac{1}{20}$". Grid condenser, 0·002 mfd. (2) For short waves, using any type of slab coil, the best combination of tuning and reaction coils requires careful selection, also the A.T.I. and A.T.C. should be in series. The grid condenser is much too large ; it should be about one-tenth of its present value. L.R. telephones are inefficient without a transformer. Details for making one have been given several times recently. Connect a 0·001 mfd. condenser across telephone transformer H.R. winding. When these changes have been made there should be a great improvement in your short wave reception.

**"MUNCASTER" (Clapham Common).**—A four-valve diagram is given in reply to **"B.D." (Leeds)** in May 27th issue.

**"NOVICE" (Loughborough)** *asks* (1) *If possible to obtain a set of drawings for construction of a* 3-*valve set.* (2) *If a number of telegraph wires passing over house will interfere with reception.* (3) *If advisable to run aerial at right angles to them.* (4) *A wireless book suitable for an amateur.*

(1) We do not know where any such drawings may be obtained. The article commencing on page 13 of the April 1st issue should be of great assistance to you. (2) and (3) If wires pass over the house we are afraid a certain amount of interference will be unavoidable. The aerial should be at right angles if possible. (4) "The Amateur Valve Station," by Alan Douglas, from the

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publishers of this journal (price 1s. 6d.), or the 1920 Admiralty Handbook will be found most useful.

"**F.B.**" **(Westcliff).**—We cannot give size of basket reaction coils for your set, as you have given no particulars of the A.T.I. winding.

"**C.J.F.** (**Stafford**) *asks* (1) and (2) *For two and three-valve circuits.* (3) *Suitable telephone transformer for* 100 *ohm loud speaker.* (4) *Information regarding R.A.F. spark set with* 9,000 *volts transformer.*

(1) and (2) The circuit given in Fig. 4, page 32, April 8th issue, will allow either of the desired combinations to be used. (3) Any good standard transformer will do. A suitable one will be 3 ozs. of No. 44 and 6 ozs. of No. 32, wound on ½" soft iron core, 3" long. (4) This is probably a set which was supplied with power from a propeller driven A.C. generator. We are sorry we have no information regarding the A.C. power required for transformer primary, and suggest that you apply to the B.T.H. Co., giving, if possible, the number of set and transformer.

"**TRANSMITTER**" **(Leicester)** *asks for particulars of a 2-valve transmitter to work on a* 10" *square frame aerial.*

It is almost an impossibility to make such a set as you require. The circuit given in Fig. 2, page 185, May 6th, would be a suitable one for you to begin with, using an open aerial.

"**W.M.S.**" **(Dundee)** *asks for a tuner with reaction coil for* 400 *to* 5,000 *metres to use with a two-valve set.*

The simplest arrangement will be to use a single layer A.T.I. with sliding reaction coil. This may be A.T.I. 6"×12" of No. 28, with 5"×10" of No. 28 for reaction. A more compact tuner may be made with honeycomb or slab coils. A set of 6 coils will probably be required, wound on 2" diameter former, 1" to 2" deep, with 30 turns to smallest and 600 turns to largest coil.

"**J.W.**" **(Warrington)** *asks* (1) and (2) *For information regarding a transformer marked* "F542." (3) *For efficiency of a* 1/1 *transformer wound with No.* 42 *wire.* (4) *Wavelength of a crystal set.*

(1) and (2) We are unable to recognise the transformer from the details given. (3) It is difficult to say without test. If there is not much leakage it may be 75 per cent. efficiency. (4) Maximum wavelength 4,500 metres approximately. No. 28 wire is too fine for aerial circuits when valve reaction is not used.

"**REACTION**" **(Edinburgh)** *has a single valve reaction set which does not give satisfaction.*

This circuit is badly proportioned: 0·0035 mfd. is far too much capacity to have in parallel with such a small amount of A.T.I. This should be reduced to 0·001 mfd. at the most, with a corresponding increase in the A.T.I. winding. For short waves A.T.I. and A.T.C. should be in series. Present maximum wavelength is about 9,000 metres and minimum about 2,000. When the alterations suggested are made, the set will not oscillate so vigorously, so that the musical spark stations will not sound husky.

"**G.P.T.**" **(Coventry)** *asks* (1) *For inductance and wave range of A.T.I. described when used on a P.M.G. aerial.* (2) *If it may be used in a two-valve set.* (3) *If slab or basket coils may be used in conjunction with A.T.I.* (4) *Dimensions of condensers.*

(1) and (3) Inductance of solenoid 5,400 mhys; maximum wavelength, 2,000 metres. One of the sphericals should be used as coupling and joined in series with some basket coils to form the secondary circuit. The reactance may consist of basket coils coupling into the basket coils of the secondary circuit. (2) Yes. (4) When asking for condenser dimensions it is advisable to give the size of plates available. For both aerial and secondary circuits 0·0005 mfd. condenser may be made. If the plates are approximately 3" diameter and the spacing between fixed and moving vanes $\frac{1}{16}$", 19 fixed and 18 moving vanes will be required.

"**R.L.T.**" **(Gravesend)** *asks* (1) *Time and wavelength of* **FL** *telephony.* (2) *Best crystal to use for receiver.* (3) *What stations other than* **PCGG, 2MT** *and* **MPD** *send out telephony concerts.*

(1) Most afternoons. No definite programme arranged. 2,600 metres. (2) Carborundum, with steel plate, is one of the simplest to use. Zincite-bornite, or galena-steel point, or galena-tellurium combinations all give good signals, but are not so stable as carborundum. (3) At present there are no other stations giving regular transmissions.

"**R.O.C.**" **(Leigh-on-Sea)** *asks* (1) *For a two-valve circuit for beginner.* (2) *For particulars of transformer in circuit recommended.* (3) *Names of two stations* "*nearly always working on* 700 *to* 1,000 *metres.*"

(1) The circuit given in Fig. 1, page 119, April 22nd issue, should be quite suitable. (2) The inter-valve transformer should be wound on a ½" diameter soft iron core, 3" long. The primary should have 1 oz., secondary 3 ozs. of No. 44. The telephone transformer should be 3 ozs. of No. 44 and 6 ozs. of No. 32 on the same sized core. (3) We cannot say.

"**H.A.**" **(Salford)** *asks* (1) *Capacity of condenser.* (2) *For diagram to add two-valve H.F. panel to existing three-valve panel.*

(1) The capacity is 0·001 mfds., if the $\frac{5}{32}$" spacing refers to distance between fixed vanes. (2) Diagram of additional panel is given in diagram (Fig. 4). It is not necessary to use separate batteries for this panel, unless it is specially desired to do so.

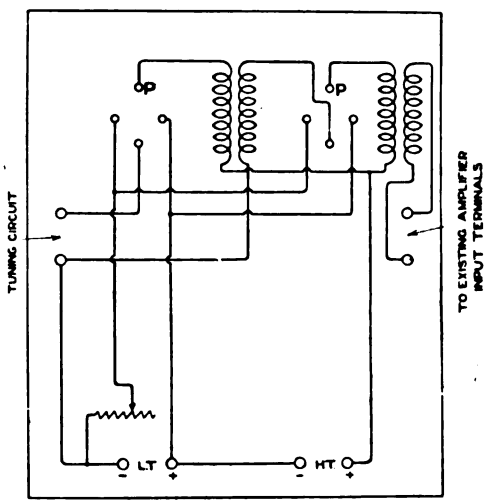


*Fig. 4.*

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**"W.H.P." (Bridgwater)** *asks* (1) *If possible to hear* **PCGG** *on two-valve set.* (2) *What English telephony should he hear.* (3) *If safe to connect earth lead to a water-pipe.* (4) *Wavelength range of set.*

(1) Yes, though some experimenting may be necessary. An additional H.F. valve would make it more certain. (2) Croydon and **2MT** telephony should be heard. (3) Yes. (4) No particulars of the set are given which would enable us to calculate the wavelength range.

**"E.A.W." (Derby)** *shows two-valve diagram, and asks* (1) *If* 8,000 *ohm telephones may be used with circuit.* (2) *Should H.T. be* 60 *volts for "Ora" valves.* (3) *Any objection to common terminal for negative H.T. and positive L.T.* (4) *Suggestions for improvement of set.*

(1) It is fairly safe to use them if connected in the negative side of the H.T. (2) Yes. For all resistance amplifiers the H.T. should be about twice the normal anode voltage to allow for voltage drop across resistance. (3) No. (4) Provision of series-parallel switch for the aerial condenser would be an improvement.

**"A.R.C." (Sheffield)** *asks* (1) *If corrugated iron sheeting* $8' \times 2\frac{1}{2}'$ *is a good earth.* (2) *Would connection to water-pipe* 20 *yards away be more efficient.* (3) *Criticism of single valve set.* (4) *Suggestions for strengthening signals, which are very weak.*

(1) This is hardly sufficient. Bury it deeply in damp earth and also make connection to water-pipe with a stout cable. (3) The circuit is correct, except that there should be a 0·001 mfd. condenser across the anode winding of telephone transformer. As no information is given regarding inductances, it is not possible to say if there is sufficient reaction. (4) 4 volts with a filament resistance is not sufficient for any valve. Increase to 6 volts. Make certain that telephones are connected to L.R. winding of transformer. The set is not sufficiently described for us to give further help.

**"Q.R.A." (Boscombe)** *asks questions regarding grid condenser and leak.*

It is not necessary to have either variable condensers or leaks. A 0·0003 mfd. condenser with 2 megohm leak across it is very useful for short wave spark and telephony signals. The Mark III potentiometer is not suitable for use as a leak. You will see how to connect a condenser and leak in circuit from Fig. 1, page 119, April 22nd issue.

**"L.B.S." (Wallington)** *asks* (1) *If separate heterodyne will make three-valve circuit more selective than using capacity reaction.* (2) *If Mark III tuner former with variable condenser may be used for heterodyne for all wavelengths.* (3) *Why set is better when H.F. transformer is tuned with a condenser and A.T.I. is untuned.* (4) *Why single valve set will not oscillate below* 1,000 *metres.*

(1) The selectivity may be improved if a separate heterodyne is used together with the capacity reaction, which should be adjusted almost to the oscillating point. (2) No. A set of slabs, similar to those used in the A.T.I. and reaction will be necessary, with variable condenser. (3) The condenser across the primary probably tunes the transformer to very near the wavelength being received, therefore increasing the efficiency of the transformer. If the A.T.I. were also tuned the results would be better still. (4) Oscillation below 1,000 metres is always more difficult than on longer waves, owing to the smaller inductances used, with consequent weaker coupling. Try as many combinations of slabs as possible and also connect A.T.I. and A.T.C. in series.

**"DUD" (Atherton)** *asks* (1) *Why speech and music are distorted on his single valve set.* (2) *For capacity in mfds. of* 10,000 *cm. Telefunken condensers, also capacity of two plates of same.* (3) *If "Ora" valves are good for a three-valve set.*

(1) You give no details of set, but the trouble appears due to tight reaction coupling. (2) 10,000 cms. is equal to 0·011 mfds. The capacity between two of these foils separated by 0·003" micas is approximately 0·00042 mfds. (3) Yes.

**"G.S.W." (Birmingham)** *asks* (1) *For criticism and wavelength range of single valve set.* (2) *What stations should be heard.* (3) *For sizes of condensers.* (4) *Best arrangement of telephones.*

(1) The circuit is O.K. and should work satisfactorily. It would be an improvement to add a switch so that the aerial condenser may be connected either in series or parallel with A.T.I. The maximum wavelengths will be with condenser in series, 1,300 metres and in parallel 2,700 metres. (2) Croydon and **2MT** telephony, together with ship and coast stations on 600 metres, and Eiffel Tower should be heard. (3) The variable condenser might be 0·0005 mfd., made up of 3" diameter vanes with $\frac{1}{16}$" spacing between fixed and moving vanes, 19 fixed and 18 moving vanes. Condenser across telephones and battery 0·001 mfd., made up with 3 foils $2" \times \frac{1}{2}"$, separated by 3 mil. micas. (4) For this type of set L.R. telephones with a transformer are advised.

**"A.M.H." (Romford)** *asks* (1) *For diagram to add two valves to existing set.* (2) *If No.* 34 *D.S.C. wire may be used for H.F. transformers.* (3) *If* **PCGG** *will be received on set.*

(1) The diagram given in Fig. 4, page 32, April 1st issue, may be used for your purpose, if the grid condenser and leak are connected in grid circuit of No. 2 valve. (2) It is useful for short wavelength transformers, but makes them rather bulky. No. 40 is a better size. (3) Yes.

## SHARE MARKET REPORT.

Prices as we go to press, May 26 h, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 16 | 0 |
| ,, Preference .. .. | 2 | 10 | 0 |
| ,, Inter. Marine .. .. | 1 | 14 | 9 |
| ,, Canadian .. .. | | 12 | 9 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 4 | 6 |
| Preference .. .. .. | | 15 | 3 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 11. JUNE 10TH, 1922 WEEKLY

## The Valve Transmitter of the Eiffel Tower

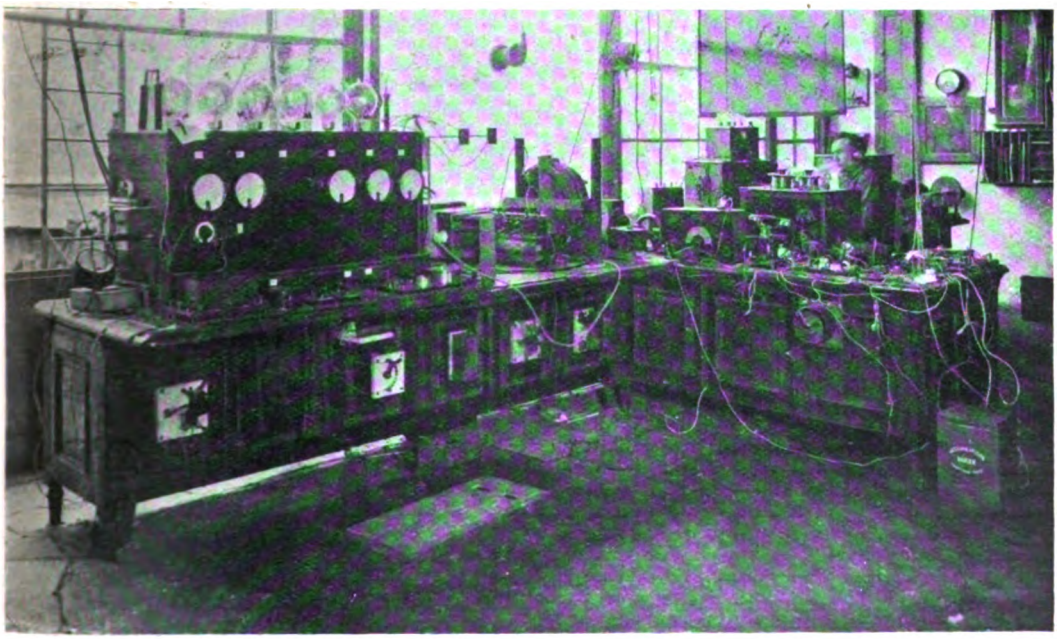
By E. MAURICE DELORAINE, Ing. E.P.C.I.

### I.—HISTORICAL.

OUR intention is to give, as far as possible, a general description of the radio-telegraphy and telephony station of the Eiffel Tower. We shall begin by describing the valve transmitting station, because of the present great interest in radio telephonic broadcasting.

The first experiments in connection with this transmitting set were made in April, 1921. The question was then complicated by the fact that triodes capable of delivering large power were not available in France. The tubes on the market were first studied, and when this question had been roughly solved, the circuit itself was considered with a view to telegraphy. This was practically settled in September, 1921, and after this date efforts were directed towards adapting this installation to radio-telephony.

The set now used is experimental rather than commercial. It is the result of widely varied experiments, and the original ideas have been modified in many respects. A part of the apparatus might almost be called "junk." The erection of the set is entirely due to the military and civil



*The Eiffel Tower Telephony Transmitter.*

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personnel of the Eiffel Tower under the distinguished direction of the Chief Engineer, Mr. Laüt.

### II.—TRIODES.

Three different types of triode can be used without involving any rewiring of the set. We shall cite the "Neuvron" type of triode (Fig. 1), made by Gaumont, the firm so well known in the cinema world. It stands about 14 inches high, takes a filament current of 5 amps. at 18 volts with a maximum plate filament voltage of 3,000 for model A, and 1,500 for model B. The input on the anode may amount to 500 watts without over heating. The anode in the form of a vertical nickel cylinder corrugated to increase its rigidity and radiating surface.

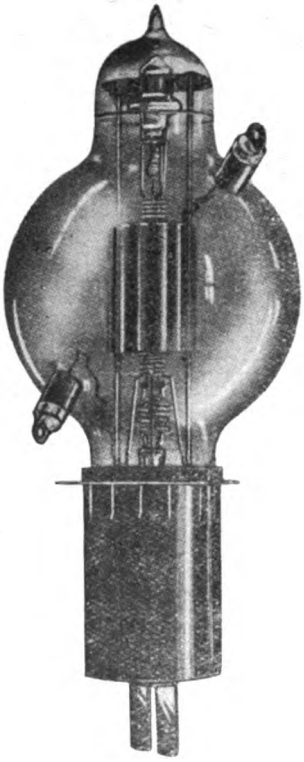

*Fig. 1. A "Neuvron" Valve.*

The grid is a spiral, coaxial with the plate. The filament is a closed V, supported at the top by a spring which keeps it in tension when hot. The ends of the V are joined to the socket by a zig-zag metal tape, which being capable of dissipating heat easily, prevents the glass from cracking owing to overheating. The bulb is exhausted as completely as possible, and the electrode submitted to an intense electronic bombardment to remove occluded gas. Partial sublimation of the metal takes place blackening the glass and thereby sometimes reducing the insulation of the electrodes.

The lamp should be placed in an upright position, and the bulb cooled by a downward current of air.

Another type of triode is made by S.I.F. (Société Indépendante de T.S.F.). This tube (Fig. 2) s

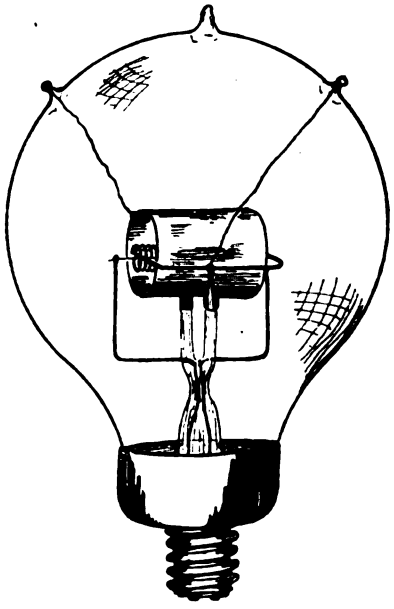

*Fig. 2. A S.I.F. Valve.*

somewhat smaller. It takes about 4 amps. at 12 volts and the input in the plate circuit at 2,300 volts is about 300 watts. The arrangement of the electrodes resembles closely the French type valve, but the plate is an eliptical cylinder instead of a circular one, and, being of tungsten, it may become red hot without danger of being perforated. The filament is a straight horizontal wire, and the grid a concentric spiral.

The socket is of the "Edison" type.

The third type of triode for which sockets were provided was that made by the Pilon Works, but it has not so far been used.

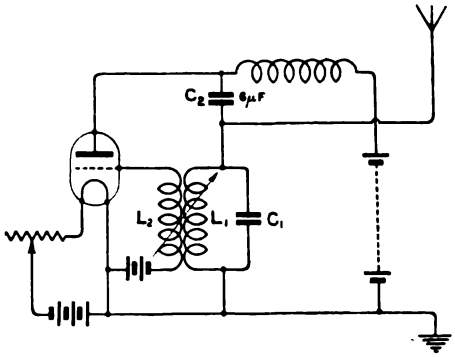


*Fig. 3. The Circuit of the Telegraphic Transmitter.*

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The first two types give highly satisfactory results. In Fig. 5, tubes 1, 2, 3, 4, 5, 6 are S.I.F. make, and 7, 8, 9 Gaumont.

### III.—TELEGRAPHY.

Fig. 3 gives the circuit diagram of the telegraphic circuit. The different triodes (4, 5 or 6 in number), are all in parallel and maintain the oscillations in the circuit $C_1$ $L_1$ in the plate circuit. This circuit reacts on the aperiodic grid circuit through a variable magnetic coupling $L_1$ $L_2$. The antenna-earth circuit is set to the wavelength of the resonant circuit by means of a variable condenser.

(*a*) *Filament Circuit.*

The filament current is supplied by a battery containing 10 units of 300 ampere hours. This battery normally works in parallel with a shunt-generator capable of giving 50 amperes at a tension up to 30 volts, the excitation of the machine being controlled by the rheostat 10 (Figs. 4 and 5). The potential across the terminals of the machine, or across the battery, is read on voltmeter 20, for a suitable position of commutator 19. The excitation of the machine is regulated so that the generated voltage slightly exceeds that of the battery, and the two may then be coupled without danger by means of the circuit breaker 34. The latter would prevent current from flowing back from the battery to the machine. The total filament current is read on ammeter 21, while a differential ammeter (26) indicates the amount of current supplied by the battery and the machine respectively.

The potential drop across the filaments must be kept as nearly constant as possible during working, as a reduction of tension causes a corresponding diminution of the current in the antenna, and, on the other hand, excessive heating shortens the life of the triodes considerably. When the pressure across the filament exceeds the normal value by 1 volt, the circuit breaker (31) is actuated by the relay (29). A small commutator (18) is used to change the working point of the relays when the type of triode is changed.

Separate rheostats (10 to 17) allow the current and voltage to be set at the value specified by the maker of each type.

In the filament circuit there are included a commutator (30) which switches off the current, and fuses (35).

(*b*) *Grid Circuit.*

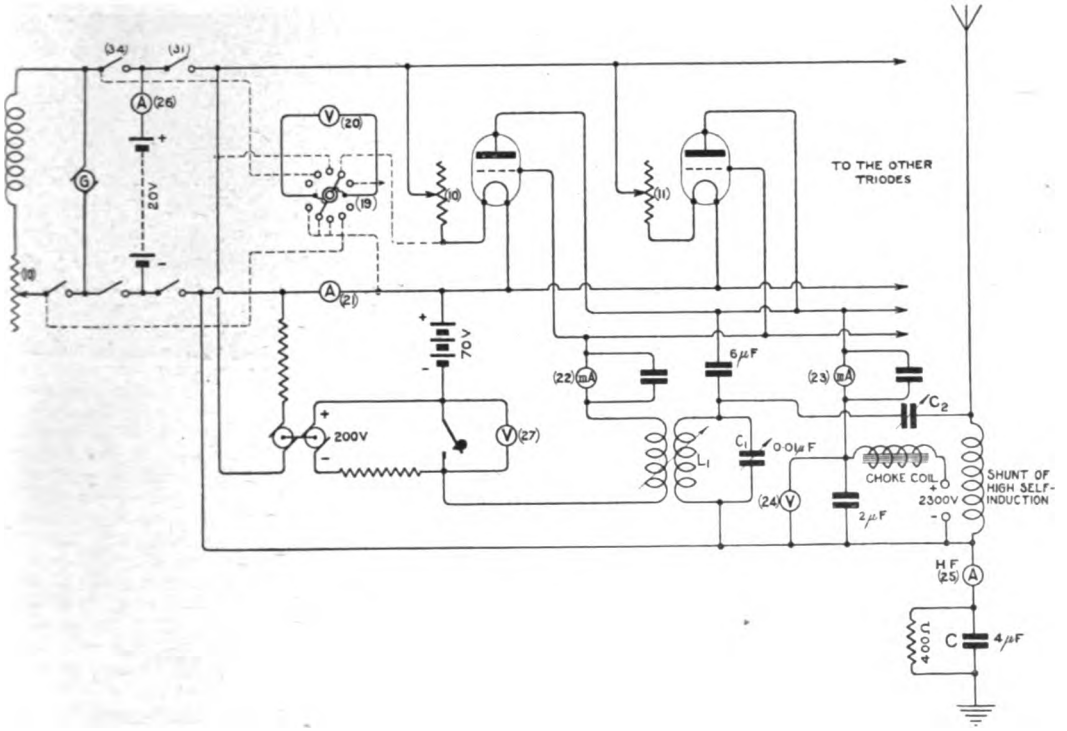


*Fig. 4. Transmitter Circuit.*

The grids are wired in parallel and kept at a negative potential of about 70 volts by a battery of small capacity. The use of very negative grids, removing as it does the working point to the bottom of the grid plate characteristic, results in the production of an impulse only during the positive half cycle.

This gives an overall efficiency greater than would be obtained at the middle of the straight part of the characteristic.

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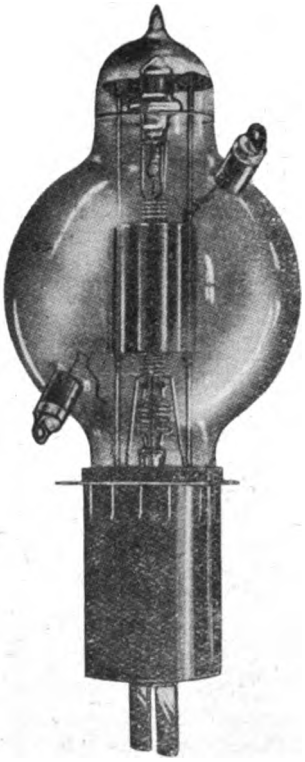

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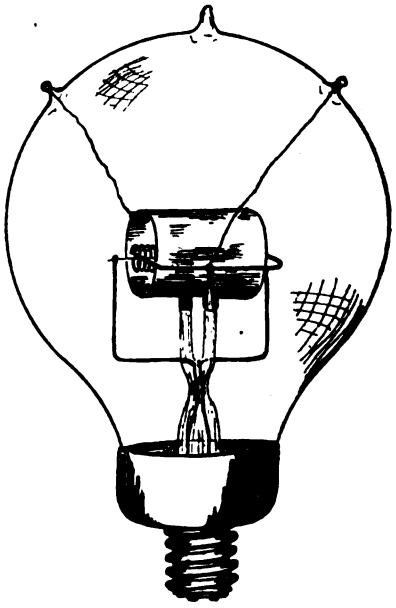

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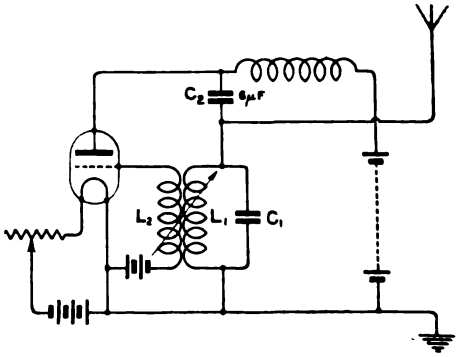


*Fig.* 3. *The Circuit of the Telegraphic Transmitter.*

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The potential drop across the filaments must be kept as nearly constant as possible during working, as a reduction of tension causes a corresponding diminution of the current in the antenna, and, on the other hand, excessive heating shortens the life of the triodes considerably. When the pressure across the filament exceeds the normal value by 1 volt, the circuit breaker (31) is actuated by the relay (29). A small commutator (18) is used to change the working point of the relays when the type of triode is changed.

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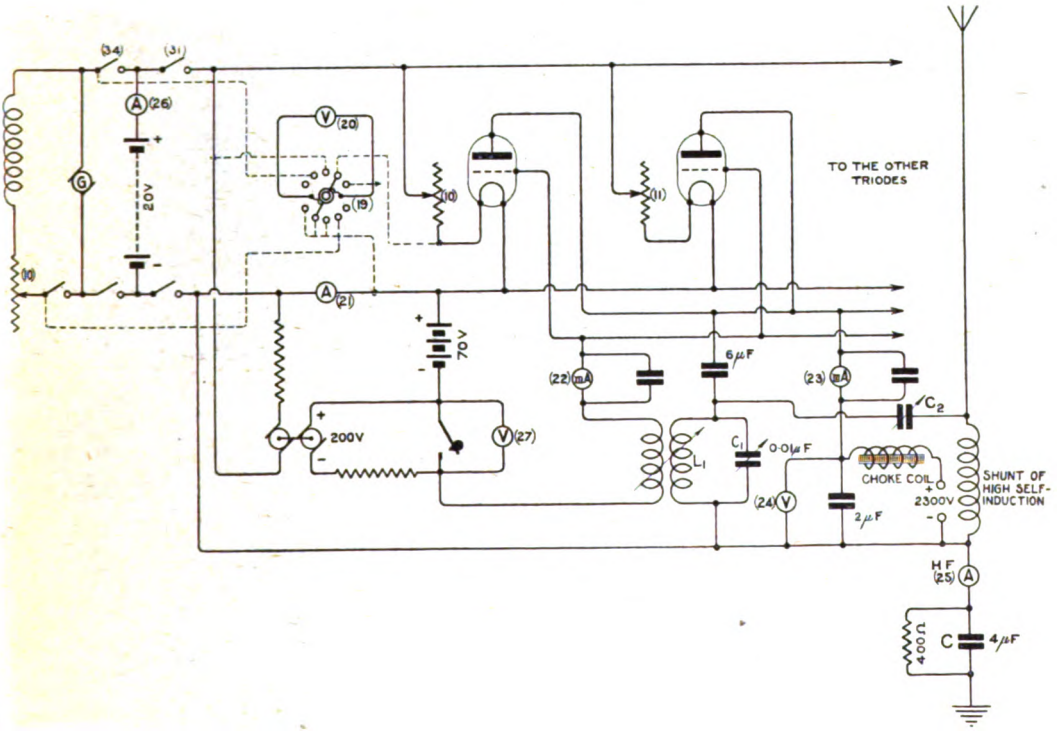


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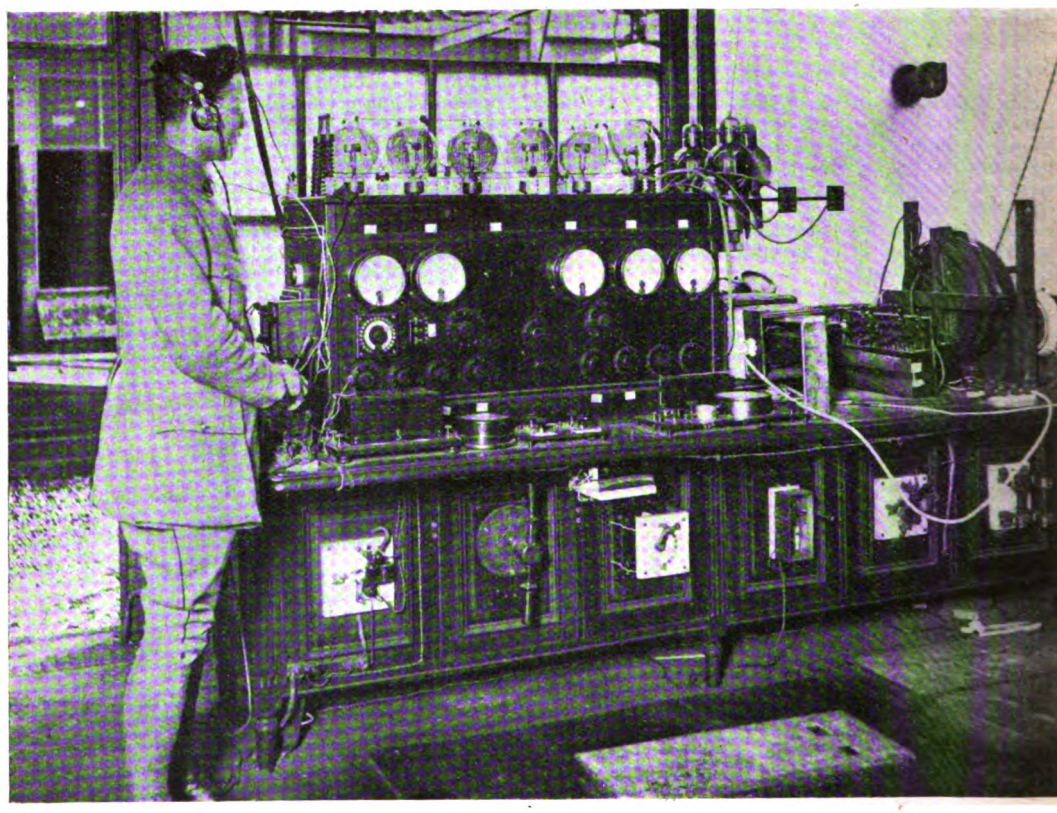

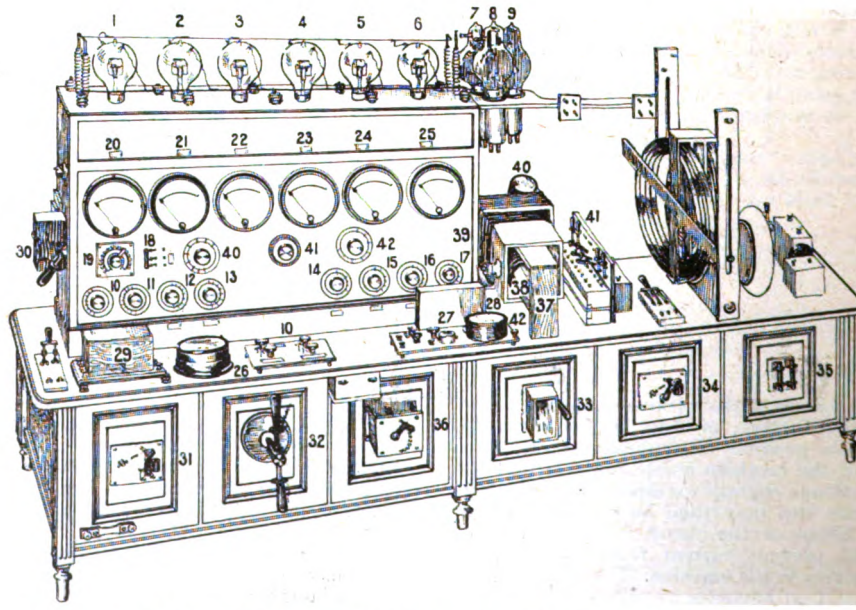


*Fig. 5. The Transmitting Apparatus with explanatory diagram.*

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varied in steps by means of a commutator (40). A milliammeter (22) shunted by a condenser makes it possible to verify that the grid current remains very small.

(c) *Method of Signalling.*

To signal, the grid is made very negative by introducing a supplementary negative potential of about 200 volts (Fig. 4), which may be read on the small voltmeter (27). This negative tension is supplied by a small D.C. motor-generator, with two commutators, on one of which 20 volts is placed to work the machine, while from the other a tension of about 200 volts is taken. This dynamo starts automatically when the triodes are lighted.

The key short circuits the supplementary tension, the current supplied by the machine flowing in this case through a resistance. The signalling can be done by hand or Wheatstone, this system being able to work at very high speeds without any sparking at the contacts of the key. If desired, the triodes can be worked at their maximum power, when the key is on the marking stop, as when the key is up, the electronic bombardment is stopped by the grid, and the plate has time to cool. Under these conditions of working, the key should not be kept depressed as the plate becomes excessively hot.

(d) *Plate Circuit.*

The plate circuit is common to all the triodes. The resonant circuit $L_1C_1$ consists of a condenser of 0·01 microfarad and a self-induction $L_1$, whose value is varied by means of a contact (42). The degree of coupling between grid and plate is varied by means of a variometer (41). The antenna and earth are connected to either end side of the oscillating circuit. The capacity of the antenna itself is 0·007 microfarads, and it is connected in series with a variable condenser $C_2$. The wavelength of the complex circuit then obtained is set at 2,600 metres.

The plates are fed through a choke coil. A passage for high frequency oscillations is provided through a 6 microfarads condenser, connecting the plate to the oscillating circuit. This condenser has a large value as it acts as a reservoir. The grid is kept at a high negative potential, and the current impulses in the plate circuit are short and sharp. The condenser supplies instantaneously the current demanded in the plate circuit when the grid potential becomes sufficiently positive. The peaks of the plate current are very sharp, and give rise to an induced E.M.F. capable of maintaining a heavy oscillating current in the antenna, although the mean power taken from the high tension source is comparatively small.

It is not wise to have an antenna of the size of that in the Eiffel Tower, completely insulated from the earth, on account of the very large static charges which may accumulate on this antenna. A shunt of high inductance is provided, to allow these static charges to pass to earth, without, however, affording a passage to high frequency oscillations. As it was undesirable to earth directly one side of the high tension supply, a condenser of 4 microfarads is put in series between the antenna and ground, but is shunted by resistance lamps.

The mean plate current is measured by a millimeter (23), the plate voltage by a voltmeter (24), and the oscillating current in the antenna by a hot wire ammeter (25). With the apparatus it is naturally necessary to depress the key for several seconds to obtain the maximum deflection. If the triodes are delivering high power this is very inconvenient as the plates get excessively hot. Furthermore, during Morse-working the deflection of the needle is varying all the time without bearing a definite relation to the current in the antenna.

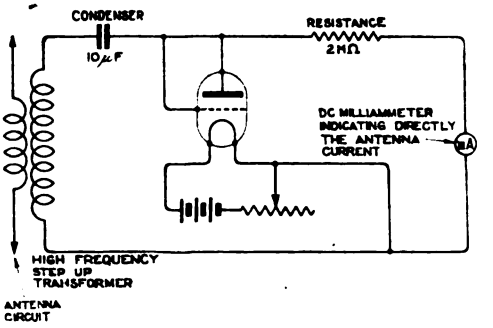


*Fig.* 6.

To overcome these difficulties a second ammeter has been provided which gives at any instant during working the maximum effective current in the antenna. The antenna is magnetically coupled with a secondary circuit of about two hundred turns (Fig. 6). The latter is connected on one side through a highly insulated condenser of 10 microfarads to the plate, and on the other to the filament of a small R triode. This condenser is charged to a potential equal to the peak value of the oscillations and discharges very slowly through 5 meghoms. When working commences the condenser is charged in a couple of seconds and reaches its maximum potential. The needle then gives directly the value of the current in the antenna, and the reading is not influenced at all by the speed of working or the nature of the signals.

(e) *High Tension Supply.*

The plate supply was originally drawn from a ring wound generator driven by an asynchronous motor. An oil circuit-breaker (32) is inserted on the side of the high-tension supply. A commutator (33) controls the excitation, and a rheostat (36) allows the tension of this machine to be varied.

After an accident that happened to this machine, Mr. Laüt proposed the use of a system of rectified alternating currents. The source being the local supply or 220 volts at 42 cycles, which is stepped up through a transformer. A synchronous motor works a rotating brush which alternatively connects at the moment of maximum tension, positive or negative, the secondary of the transformer to one or other of the condensers C or C′. (Fig. 7).

This result is obtained in practice by the use of a small four-pole synchronous motor. A metallic arm is well insulated from the motor, and carries at each end a small wheel which in the course of one revolution connects successively a to c and b to d; a b c d being contacts placed at 90° around the periphery. These contacts consist of bow-shaped elastic steel wires of 1 millimeter diameter. These contacts are fixed on a movable ebonite mounting plate, which can be turned through such an angle that the contact is made at the time of

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maximum voltage. The condensers C and C' have a large capacity: 15 microfarads. They are each charged 42 times per second and always in the same sense. Thus a continuous current can be obtained between the terminals of these condensers, with an undulating voltage. The fluctuations are partially choked out by the use of a choke coil in series and condensers in parallel, which at the same time prevents the return of high frequency current into the transformer.

The final fluctuations are of such small ampli-

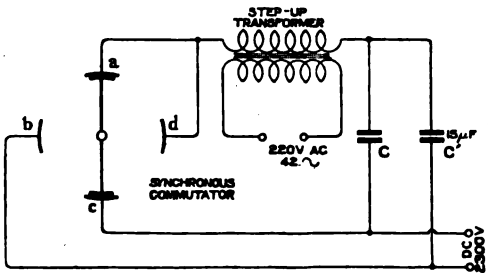


*Fig. 7.*

tude that they are not detected by a receiving set even when close to the sending station.

IV.—TELEPHONY.

The circuit used for telephony is exactly the same as for telegraphy, except that the signalling apparatus is replaced by a modulating device.

(*a*) *Oscillator.*

A new triode maintains in a resonant circuit a.b., oscillations whose frequency corresponds to the allotted wavelength.

The triodes in parallel have in their grid circuit a new self-induction $L_3$ which is inductively coupled with the oscillating circuit of the oscillator. These grids are further raised to a negative potential of 120 volts (Fig. 8).

The oscillations set up by the oscillator are thus transmitted inductively to the grids of the triodes and reproduced amplified in the plate circuit. The antenna circuit is then tuned to the same frequency, by adjusting condenser $C_2$. Thus the maximum current in the antenna is obtained. A retroactive coupling between the inductance $L_1$ in the plate circuit and $L_2$ in the grid circuit of the triodes compensates for damping in the circuits and further increases the amplitude of the oscillations. The advantage of the system is that the periodicity of the antenna oscillations is not determined by the characteristic of the antenna, but by the period of the oscillating circuit of the oscillator, with the result that the wavelength emitted is very nearly constant, and the inevitable variations in the capacity of the antenna, for example, do not cause variations in wavelength.

We may remark by the way that this kind of circuit would be very advantageous in high speed printing telegraphy where sharp tuning is used, and therefore the wavelength must be kept constant within extremely narrow limits.

(*b*) *Modulation.*

The first triode also plays an important part in modulation, as it is the oscillations in its circuit which are first modulated by the voice currents.

The speech waves may be generated in a microphone on the set, or transmitted over a special line-circuit from the local switchboard. The voice frequency currents are first of all amplified by means of a two-stage amplifier.

The triodes used in this case are small French tubes with cylindrical grid and plate. The coupling between the microphone circuit and the first grid and also between the plate circuit and the second grid is made through step-up transformers. The grid potential is—6 volts to avoid the distortion which would result from the current which other-

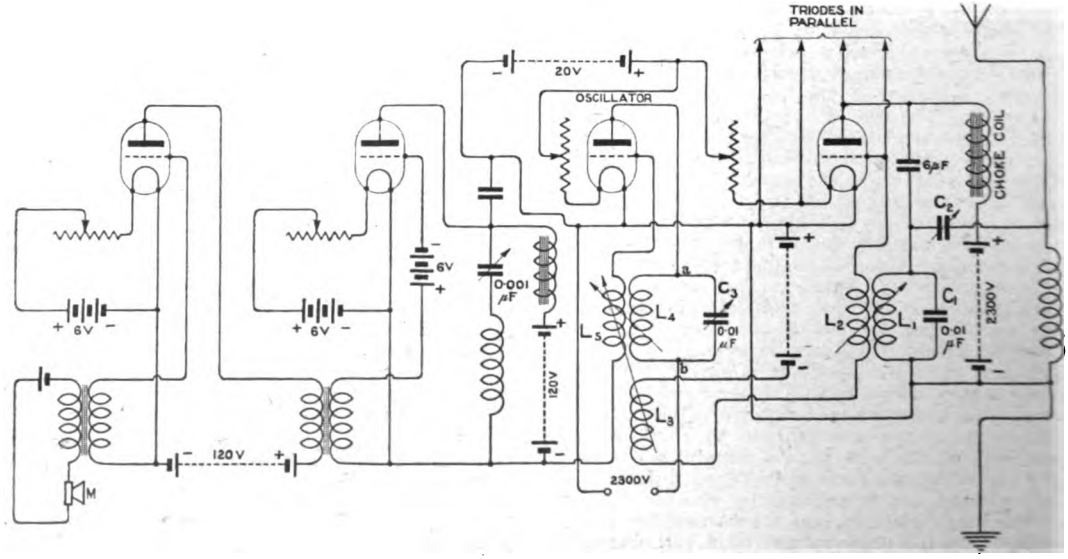


*Fig. 8. Details of the Telephony Circuit.*

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wise would flow in the grid circuit at the points of maximum the positive potential. In the plate circuit of the second tube a self-induction and a condenser of about 0·001 microfarads are placed in series.

This impedance is necessary to obtain on the grid of the oscillator a potential varying according to the speech wave.

The local oscillations of circuit a b are thus modulated to telephone frequencies and through the coupling $L_2$ $L_3$ these modulated oscillations are transmitted to the antenna circuit. However, there exists a direct coupling between the self-inductance of the grid circuit of the oscillator and that of the triodes. The quality and amplitude of the modulation depends upon a correct degree of coupling between the inductances.

Referring back to Fig. 5, the self-inductances $L_2$ $L_3$ $L_4$, are indicated by the numbers 37, 38, 39. It is possible to change their respective positions to obtain a coupling which gives a modulation which is very nearly perfect.

No. 40 is an ammeter in the oscillator circuit and No. 41 is the capacity $C_3$ (Fig. 8).

The adjustment requires a high degree of skill and it is possible that a simpler circuit may be adopted later. It is, however, interesting to note that, contrary to what is often thought, excellent modulation may be obtained by merely varying the grid potential. Mr. Levy, in 1916, had already fixed up a set, with a range of 300 miles, giving excellent results, with grid modulation.

mitting the switch automatically disconnects the sending side from the antenna, serious consequences being thus avoided.

### V.—Efficiency.

The overall efficiency of the set is relatively high. This is due in the first place to the use of a very negative grid, which causes only sharp current peaks in the plate circuit.

Furthermore the use of an oscillator with an initial frequency constant to within narrow limits, allows the different circuits to be sharply tuned to the conditions of maximum efficiency. When once this setting has been made it does not need readjustment.

When the set transmits under the following conditions :—

1. Non-modulated continuous waves of 2,600 metres. Corresponding to 7·5 ohms of effective antenna resistance.
2. With 5 triodes in parallel
3. With a plate voltage of 2,300 volts.

We have the following figures :—

| | | |
|---|---|---|
| Input plate current | 0·550 | amps. |
| Input energy on the plates | 1,265 | watts. |
| Effective antenna current | 9·6 | amps. |
| Energy in the antenna | 690 | watts. |
| Efficiency | 55 | % |

When the oscillations are modulated the effective current may reach 11·5 amps. in the antenna. This corresponds to 1 kW. The efficiency is then less—about 50 per cent.

The exact degree of modulation is not known

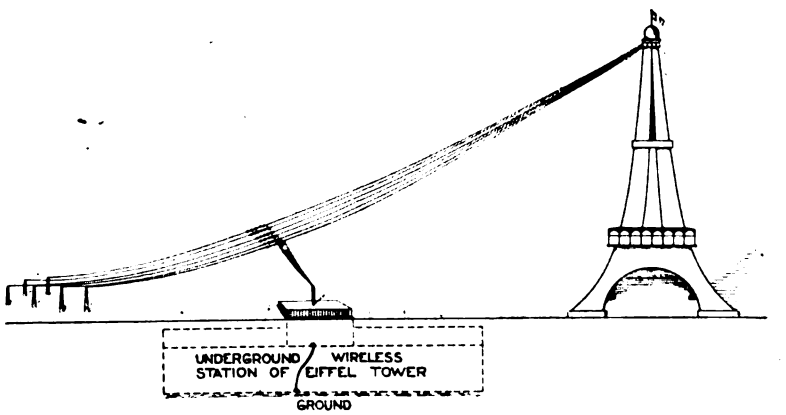


*Fig. 9. Arrangement of the Antenna at Eiffel Tower.*

*(c) Antenna.*

The antenna used is the large one of the Eiffel Tower, consisting of 6 galvanised steel cables fixed at the top but insulated from one another. They are led down like the guy ropes of a tent, and joined together where they enter the post (Fig. 9). The antenna capacity is 0·007 microfarads, and its natural wavelength about 2,000 metres. The earth consists of a large number of zinc plates buried under the station and having a total surface of 600 square metres. The antenna switch for the triode set is controlled electrically by a button (42). If by mistake the operator passes to the receiving position while the set is still transprecisely, as no oscillogram has been taken for the antenna current.

It is, however, possible to get an idea of the amplitude of the modulation by comparing the antenna current with and without modulation.

### VI.—Results Obtained.

The results observed by the many posts that hear the Eiffel Tower's radio-telephony show that the quality of emission has been continually improving. This is due to more accurate setting and greater skill on the part of the personnel.

The receiving sets include the amateur's set using a simple crystal detector, as well as the specialist's

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set with a perfected selective set using multi-stage amplification.

In a general way it seems that amplified reception at high frequency with resistance coupling has given the best results, as far as clearness and distinctness of speech is concerned. A very high degree of selectivity may be used, reducing the effects of atmospherics and interference due to other stations, to a minimum.

We shall cite the following results :—

(1) 180 miles from Paris a simple direct coupled receiving set with a galena detector and 3-wire antenna, 260 feet long and 65 feet high, gives excellent reception.

(2) At the Hague, 250 miles from Paris, a correspondent of *Radio News* writes to say that he could hear very distinctly with a 4-wire antenna, 80 feet long and 13 feet above the roof by using a single triode.

(3) At Genoa, 260 miles from Paris, very strong clear reception, with a retroactive circuit on a twin wire antenna 180 feet long is reported.

(4) At Milan (400 miles) a 3-triode amplifier (the first tube being used at high frequency with retroactive coupling, and the other two at low frequency) gives reception with a loud speaker on an antenna 50 feet long when the first lamp works as an autodyne. Otherwise the speech is weak. In both cases there is a certain amount of distortion.

(5) At Edinburgh (620 miles) a 4-triode amplifier (a high frequency tube, a detector with retroactive coupling two low frequency tubes) reproduces music clearly 12 feet from the telephones, using an antenna 100 feet long. Speech is slightly distorted.

(6) At Colomb-Bechar and at Ouargla (1,200 miles) the operators notify us that the reception is very good with the normal antenna using a 4-triode resistance-amplifier.

The Eiffel Tower transmits daily by radiotelephony a report of the national meteorological bureau indicating the weather expected on the next day in different districts.

This forecast, which was first of all sent out at 4.30 p.m. (Greenwich time), is now wirelessed at 6 p.m. summer time.

On account of the importance of a knowledge of the weather for certain industries and for agriculture, a second daily bulletin is being considered.

The transmission of Press and financial news is being studied at present by the Postal Administration, but such a service cannot really be satisfactory until 2 sets of at least 2 kW have been substituted for the present temporary one, whose power is less than 1 kW.

We wish to express our thanks to Mr. Le Commandant Jullien and Mr. Laüt for kindly allowing us to use information published in an article in the *L'onde Electrique*.

# Charging Accumulators from A.C. Mains

By HAROLD E. DYSON.

A VERY large number of amateurs put themselves to the inconvenience of carrying their accumulators a mile or more to be recharged simply because their supply current is alternating and they believe that troublesome or costly apparatus is required to rectify the supply.

The principle of a simple apparatus that will serve the purpose will be seen from Fig. 1. A steel reed E of thickness 0·015 ins., is supported on edge and clear of the wooden base by the brass angle bracket C. It is free to vibrate but it must be tuned to vibrate at the supply frequency, as otherwise the movement is extremely small. This is accomplished by passing the fixing screw D through a slot in the end of the reed After completing the instrument and connecting on the supply (but not the accumulator) this adjustment is easily made, as when in tune the reed will swing from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. at the tip, and when out of tune the movement will be difficult to detect. Once the reed is tuned it will not need to be altered again. The dimensions given in Fig. 2 should be followed exactly for the usual frequency of 50 periods. For 40 periods it will need to be a little longer, and for 60 periods a trifle shorter, the right length being easily found by making it too long and cutting bits off until it will tune. The contact spring is made of steel 0·025 inches thick, and should be made exactly to dimensions for reasons connected with phase angle, which will be dealt with later. It should be firmly riveted on and fitted with silver contacts. Platinum would, of course, be better but is not essential.

The magnet A is clamped to the base by a brass strap B, with a screw through the centre. The pur-

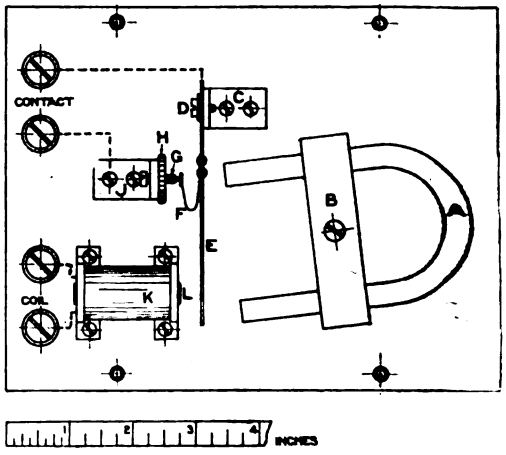


*Fig.* 1.

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pose of this is to polarise the reed, as otherwise it would only vibrate at double frequency. The best position for this magnet can be found by trial.

One of the magnets used in telephone magnetos is suitable but a less powerful one can be used successfully if carefully adjusted to be as near as possible to the reed without touching it when it vibrates.

The reed is alternatively attracted and repelled by the coil K, which carries alternating current, thus causing the contact G to be open for one-half cycle and closed for the other.

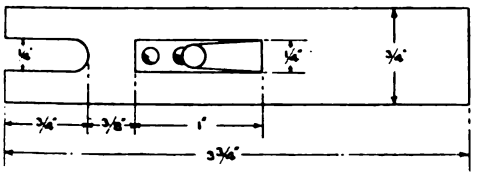


*Fig.* 2.

The coil may be fixed by a fibre strap or screwed to a small movable platform, so that it may be moved to the best distance from the reed. Movement of the iron core alone may give the requisite adjustment. The core should be about 5/16 in. diameter of ordinary iron core wire, for if solid it would not only overheat but the eddy currents would delay magnetisation. A bobbin with a winding of about 1 in. diameter by about 1½ ins. long, wound with No. 34 wire, is generally suitable.

The contact screw G in the angle bracket J is fitted with silver tip and knurled lock-nut H. It is the only thing that ever requires adjustment after the rectifier has once been set to work, and then only after the contacts have been cleaned.

It will be found that when running without sparking the contact will be open when the rectifier is stopped.

This makes any kind of cut-out unnecessary as the accumulator is on open circuit if the power should fail. If the contact be properly adjusted the reed opens the circuit when the A.C. volts have dropped to the accumulator voltage, so that no current is passing; this results in surprisingly little trouble with the contact.

All important dimensions have been given, but other dimensions may be varied to suit the maker.

The circuit to be used is given in Fig. 3, the rectifier terminals being shown at A. It will be noticed that a transformer is used. This results in a great saving of current as the 100 or 200 volt supply may be thus economically reduced to 15 volts for charging a 6-volt accumulator. This may seem too great, but it should not be reduced below this. Further reduction takes place in the resistance E. This may be a fixed resistance of 1 ohm if the rectifier is only used on a battery of 40 or more ampere hours, when the charging current will probably be about 3 amperes. If used sometimes on smaller accumulators a variable resistance should be used. It must never under any circumstances be omitted, as both the transformer secondary and the accumulator have such a low resistance that if the contact were even slightly out of adjustment, very large currents might flow which would immediately destroy the contacts and contact spring.

D is the accumulator to be charged and C is a direct current ampere meter. A moving coil ampere meter is suitable, preferably with centre zero, but if not available a simple coarse-wound galvanometer may be used if kept well away from all ironwork, especially the magnet of the rectifier.

It may be calibrated with sufficient accuracy by the use of measured pieces of resistance wire, and an accumulator. Its purpose is not only to measure the charging current but to indicate its direction. With everything connected except the main supply switch in the H.T. side of the transformer, close the rectifier contact by hand. Current will flow through the galvo. If the charging current is O.K. it will give a deflection in the reverse direction to this. If not, the accumulator must be reversed. Once correct polarity is obtained the rectifier will always start up in the correct direction.

The resistance B is unlikely to be wanted at all, the coil being straight across the transformer secondary.

It is marked on the diagram because it may possibly be found that no adjustment of the contact will produce either a sparkless break or a D.C. current. The reason for this will be that the phase relationship between the current in the coil and that through the accumulator is not correct. This may be altered by inserting in the circuit at B a 50 or 100 ohm resistance, and moving the coil nearer to the reed if necessary, to maintain vibration.

It is also possible to operate the coil from the H.T. supply side of the transformer through a lamp or condenser. This will use more energy, of course. The coil must never be put in series with either primary or secondary of the transformer.

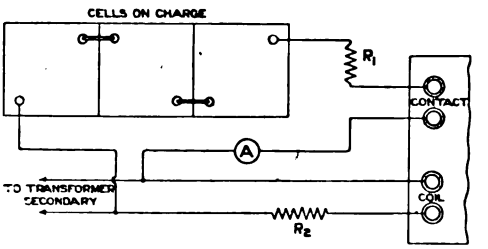


*Fig.* 3.

The rectifier from which these dimensions were taken has been in regular use for several years and runs most days for a few hours on currents from ½ to 2 amps. according to size of accumulators to be charged. It has occasionally been used on 4 amps 6 volts, with every satisfaction. It is left in circuit for 50-hour continuous runs on first charges without any attention other than cleaning the contacts with emery cloth after the run.

It is quite easy to use a split secondary transformer and a contact each side of the reed, but the arrangement illustrated has proved quite sufficient and uses an ordinary small power transformer. The energy to operate the coil is under 1 watt and no fear need be felt that the interrupted current is harmful to the accumulator.

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# The Construction of Flat Spiral Inductances

BY W. KENNETH ALFORD.

THE following notes on the design and construction of flat spiral or "pancake" inductances are the outcome of a considerable amount of research with a view to

(i) Producing a neat piece of apparatus.

(ii) Producing a "pancake" of more robust nature than that wound by the "spoke" method.

The "spoke" method, while undoubtedly appealing to the experimenter who does not possess a lathe or other mechanism adaptable to winding purposes, produces a "pancake" which when waxed is neither robust nor beautiful, especially in the larger sizes.

The method hereafter described is one which will only appeal to those possessing a lathe, and produces a truly flat spiral without the serrations appearing in coils wound by the "spoke" method, and have a very pleasing appearance.

Procure a piece of round mild steel about 4 ins. long and ¾ in. diameter. Mount this in chuck and turn down a part 3 ins. long from one end to a diameter of 2 cm. On this reduced part cut a thread ¾ in. whit, ¾ in. long. This constitutes the mandrel for winding the coils. Next procure two pieces of hard wood—mahogany or beech (the latter is preferable from the "turning" point of view) and turn two discs equal in diameter to the largest coil one wishes to make and ¼ in. thick, and drill a 1 cm. hole through each. The faces of these discs must be dead flat. A nut and washer for the mandrel completes this part of the apparatus.

Now as to the winding of the coil. Having determined the size of wire and the dimensions of the coil it is desired to make—single silk-covered wire is much preferable to enamelled wire for this method of winding—procure two discs of celluloid—aero cellon does excellently—about 0·05 in. in thickness and about ¼ in. larger in diameter than the desired coil. Drill a 1 cm. diameter hole through the centre of each and flatten if necessary by immersing in warm water and pressing.

Mount the steel mandrel in the lathe chuck by its thicker end and then place the discs on in the following order. Wooden disc, cellon disc, second cellon disc, and wooden disc, the nut and washer coming of course on the outside. The wire must now be passed between the "cellon" discs, the end being brought out through a small hole near the centre of the discs. The nut on the mandrel is now screwed up till the wire just passes comfortably yet fairly tightly between the cellon discs.

A clean tin must now be obtained, and a short length of ¼ in. copper tubing soldered into the side near the bottom, to this is connected a piece of rubber tubing ending in a piece of drawn-out glass tubing. A screw-down pinchcock is used as a tap on the rubber tubing. A dilute solution of cellulose in acetone is made by dissolving a piece of cellon 5 ins. square in 50 cc. of acetone. This solution is placed in the tin which is arranged so that the liquid may be directed through the glass end piece between the cellon discs. The winding process may now begin—allow the cellulose solution to flow between the plates at a fairly fast drip and wind as fast as safety permits. When the wire is nearly filling the slot run in as much cellulose solution as possible and screw up the clamping bolt tightly, supplementing this if possible by two or three small carpenter's cramps. Remove from lathe and leave in a horizontal position in a fairly warm and dry place for 24 hours at least. It will then be found that when the clamping nut and cramps are removed the wooden discs may be lifted off, leaving the cellon discs welded together containing the flat spiral of wire. It is now desirable to trim off any excrescences from the edges of the cellon discs and fill up any open spaces with the cellulose solution.

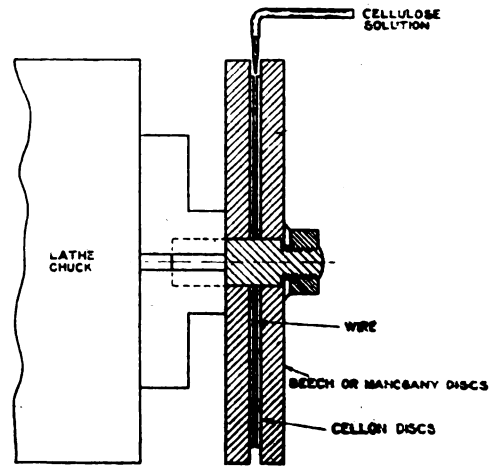


*Fig.* 1.

The resultant pancake is very robust and of pleasing appearance, and is well worth the trouble of the somewhat elaborate system adopted for its manufacture. Fig. 1 shows the arrangement for winding in a lathe. Fig. 2 is a series of curves useful in the design of "pancake" coils, allowing one to use the size of wire available, and to see at a glance the dimensions of the coil having the desired inductance.

The mean diameter is only taken up to 10 cm., as the overall diameter of such a coil is 22 cm., and the working of the winding method is liable to become cumbersome in larger coils.

Approximate wavelengths obtainable with certain inductance values and capacities of 0·0003, 0·0005, and 0·001 mfd. are given at the side of the the diagram.

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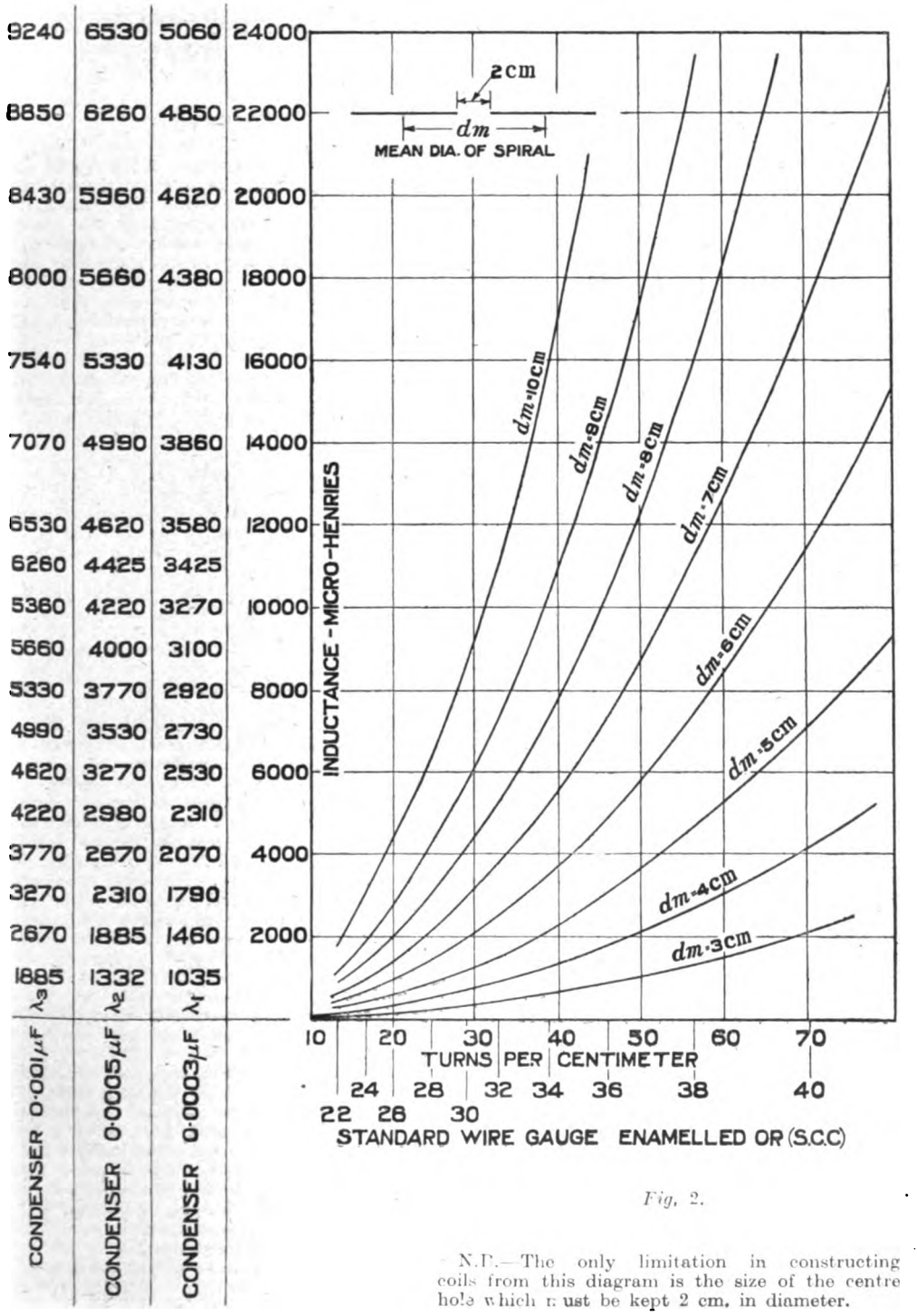


| CONDENSER 0·001μF | CONDENSER 0·0005μF | CONDENSER 0·0003μF | |
|---|---|---|---|
| 9240 | 6530 | 5060 | 24000 |
| 8850 | 6260 | 4850 | 22000 |
| 8430 | 5960 | 4620 | 20000 |
| 8000 | 5660 | 4380 | 18000 |
| 7540 | 5330 | 4130 | 16000 |
| 7070 | 4990 | 3860 | 14000 |
| 6530 | 4620 | 3580 | 12000 |
| 6260 | 4425 | 3425 | |
| 5360 | 4220 | 3270 | 10000 |
| 5660 | 4000 | 3100 | |
| 5330 | 3770 | 2920 | 8000 |
| 4990 | 3530 | 2730 | |
| 4620 | 3270 | 2530 | 6000 |
| 4220 | 2980 | 2310 | |
| 3770 | 2670 | 2070 | 4000 |
| 3270 | 2310 | 1790 | |
| 2670 | 1885 | 1460 | 2000 |
| 1885 | 1332 | 1035 | |
| $\lambda_3$ | $\lambda_2$ | $\lambda_1$ | |

10 20 30 40 50 60 70

22 24 26 28 30 32 34 36 38 40

*Fig. 2.*

N.B.—The only limitation in constructing coils from this diagram is the size of the centre hole which must be kept 2 cm. in diameter.

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# How to Get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.

(Author of "The Maintenance of Wireless Telegraph Apparatus.")

### I.—CRYSTAL RECEIVERS.

WIRELESS receivers for broadcast reception can be divided under the two headings of valve receivers and crystal receivers. Seeing that the wavelength for broadcasting has been so recently decided upon, the manufacture of sets specially designed for the purpose has not been long under way. At the present time, however, there are a number of sets in the second category already on the market, and it is thought that a few hints on how to get the best out of such sets (whatever their design or manufacture), may prove of use to the man who is just taking up wireless.

First of all, it should be clearly grasped that crystal receivers are not in themselves amplifiers of received signals, so that in such receivers, with their associated aerial and earth connections, it is imperative that all losses be cut down to a minimum. This point is of more importance in crystal receivers than in those of the valve type, as the latter, if suitably arranged, are capable of providing energy to make up *some* of the losses which may arise from inefficient arrangments, whereas in crystal receivers no such losses can be made up.

Other articles in this magazine have described the method of making and erecting wireless receiving aerials. Such aerials are invariably insulated at certain points to prevent the leakage of energy to earth; but because an aerial insulator is efficient when installed, it does not follow that without attention it will continue to act efficiently, and, indeed, in certain circumstances it may lose its insulating properties entirely.

Aerials are often erected among the chimney-pots. Frequently the mast is lashed to the chimney-stack itself, and in certain conditions, after the set has been in operation for a few weeks, the aerial wires, insulators, guy ropes, and mast, may become coated with a thick deposit of carbon from the smoke emitted by the chimney beneath.

In winter time, when heavy rains are frequent this sooty deposit is largely washed away before it has time to accumulate. With long spells of dry weather, such as we had last summer, it may, however, become very harmful. All insulators should therefore be periodically inspected and wiped with a damp cloth.

Most of the crystal detectors now sold consist of a mineral substance such as galena or fused silicon, upon which the point of a fine wire lightly rests. The surface of a crystal is never uniformly sensitive, there are always certain spots where the best results can be obtained. Dust and grease are very injurious to the surface of a crystal, and on no account should the surface be touched with the finger, or a microscopic film of grease may be formed on the surface, and spoil its rectifying properties. Some detectors are enclosed in glass or other insulating tubes, to prevent the deposit of dust, and to lessen the chance of the surface being touched.

Again, the wire point should never be rubbed, even lightly, over the surface of the crystal, or the sensitivity, which is not uniform throughout the substance, may be removed by scratching. If the testing buzzer indicates that the maximum sensitiveness has not been attained, the point should be withdrawn, and very lightly applied to another spot, any change of position being carried out only after removing the point from contact. In those cases where the wire is attached to a kind of universal joint, the whole surface can be explored point by point. In other cases, the point can move across the crystal in one direction only, in which case, once a particular line has been explored, it is necessary to rotate the crystal in its holder to find a fresh area for test. A good crystal will have many sensitive points upon it, and when such a crystal is found, it should be treated as carefully and delicately as an expensive watch.

All crystals do not require the same pressure to give the best results. Some operate best when the point rests with the lightest possible pressure upon the surface; others give better results when the pressure is quite firm. The writer once possessed a piece of fused silicon which functioned admirably even under a pressure which would have fractured many crystals. A few careful experiments should therefore be made to find the best working pressure for the particular type of crystal in use. If possible, the dealer from whom the set is purchased should be questioned in regard to this.

A crystal detector which is very sensitive when properly handled, is a combination of zincite and one of the many varieties of copper pyrites. This combination generally goes under the name of "perikon." Zincite is a reddish and very easily friable crystal, which requires careful handling. The copper pyrites used in conjunction with it is a more robust substance. If several specimens of each crystal are available, a pair should be chosen which enable the maximum number of adjustments to be made. Zincite crystals should be picked to have one portion projecting more than any other, so that this point can be placed upon any part of the surface of the opposing crystal. Some of the crystals of the perikon detectors fitted to "disposal" apparatus I have found to be very badly mounted.

In selecting copper pyrites for such a combination, see that the specimen is as flat as possible. The two crystals should be so adjusted that they press together firmly, but not too heavily. Too heavy a pressure will tend to break the delicate zincite If a zincite specimen is found to be insensitive, a tiny portion carefully broken or scraped away may reveal a more sensitive spot. Similarly, a poor specimen of copper pyrites may be improved by scraping. As before mentioned, it is extremely important that the surfaces should not be touched with the hand.

(A further article on the maintenance of wireless apparatus will appear in our next issue.)

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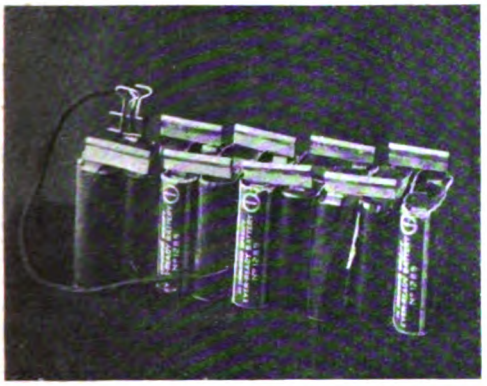
# Connecting Pocket Batteries for H.T. Supply.

BY E. VERNON BARKER.

A QUICK and effective method of connecting pocket batteries, which has the additional advantage of costing nothing, may be of interest to readers.

The usual 4-volt units are still used and preferred by a large number of wireless amateurs as being more economical than the larger units. Soldering the terminals together is the usual method employed, but the writer has come across experienced workers (one is a Transatlantic Test prize-winner) who have been content to exercise their patience by twisting bits of wire around the terminals—a most irritating and untidy-looking job. Both of these methods have obvious disadvantages.



In thinking out a better method of not only connecting but *disconnecting* these small batteries (an important point when a battery gives out and has to be replaced by a fresh one), it occurred to the writer that the back of a safety razor blade would be just the thing. So I looked out all my old "Clemak" blades (I have a habit of keeping rubbish, which frequently comes in useful years later), took off the backs with a pair of pliers, and there you have a perfect bridge ready to clip on to terminals. "Clemak," "Gem," or any single edge blade will do.

To make a neat job the negative terminals should be bent L-shape to bring them in line with the positive terminals, and then shortened with a pair of scissors to the same height as the positives.

The connecting of two small spring clips to H.T. leads will be found a good and cheap arrangement to complete the job. By clipping on to any of the bridges, tappings can be taken from either end for any voltages required. The method of arrangement is shown in the accompanying photograph.

Now it is quite possible that these old razor blades may not be easily obtained, although thousands must be thrown away yearly; so for the benefit of new radio recruits and others I will describe an easy method of making these bridges by hand. A sheet of tin will be found a most suitable material of sufficient springiness and easy to cut with a pair of scissors. Cut into small squares, size 1⅛ins. by 1¼ins. Bend double lengthwise over a short length of metal rod $\frac{1}{16}$in. to $\frac{1}{8}$in. in diameter. Leaving the rod inside, press the two sides firmly together in a vice, or with pliers, leaving the folded end projecting, which will act as a spring when in use. After withdrawing the rod replace in the vice in the same manner and screw up tightly. This completes the work, as it will be found that when withdrawn from the vice, the amount of springiness in the tin has left an opening which is just right to slip on to the flat brass terminals and make a good electrical contact.

A written description of how to make or do anything mechanical usually looks at first more troublesome than the actual work; but, without exaggeration, the writer has made two dozen of these terminal bridges in less time than it has taken to solder or twist with wire the same number of terminals.

When once you have your bridges made they can be used indefinitely, and the making or reinforcing of a high-tension battery is a matter of minutes.

# Notes.

### The Nauen Station: Extension.

The wireless plant at Nauen is about to undergo an extensive development according to a statement in the *Telefunken Zeitung*. It is stated that seven more masts 210 metres high are to be erected while four of the existing masts are to be strutted. Work is already proceeding, and the Transradio Company has increased its capital by 25,000,000 marks to obtain the requisite funds.

### Wireless Societies of the United Kingdom.

In the list of Wireless Societies of the United Kingdom, recently published, it is regretted that the name of the Edinburgh Society was incorrectly given. This Society is known as "The Edinburgh and District Radio Society." The following Society should be added to the list:—

The Wireless Society of Highgate, 49, Cholmeley Park, Highgate, N.6.

**Personal.**—Mr. A. A. Campbell Swinton, F.R.S., M.Inst.C.E., M.I.E.E., has joined the Board of Directors of Messrs. W. T. Henley's Telegraph Works Company, Ltd.

### On Heterodynes: A correction.

Owing to errors in drawings in illustration of the instalment of the article "On Heterodynes," which appeared in the issue for May 27th, we give corrections as follows:—Fig. 14 should show one moving vane less on each side.

In Fig. 16 the double switch should serve to connect $C_4$ and $C_4'$, $C_5$ and $C_5'$, etc.

In Table III the first Coil No. should be 75 instead of 50.

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# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I would very much appreciate your publication of this letter informing all British amateurs that my station will discontinue all transmitting experiments after the 30th inst., and probably until October next. Knowing that "8AB is a very familiar station to many London amateurs," I would hate to think they are tuning for me while I am not sending.

May I take this opportunity of heartily thanking the numerous British amateurs who kindly reported signals and whose help was very valuable. I wish them all success in their work and more freedom for next winter.

With congratulations for the regularity of publication of your very interesting magazine.

LÉON DELOY,
French, "8AB."

*May 28th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—My letter to the *Wireless World and Radio Review* of May 6th, regarding the many errors made in the daily press regarding radio science has brought me such a huge correspondence from persons who are interested in wireless that I venture once more to make a few remarks—this time to the amateur.

Now that we have entered upon the field of the most wonderful of nature's secrets it surely behoves everyone to study and thoroughly understand the functions and reasons for every unit of wireless apparatus. To-day there are thousands of people rushing to purchase complete receiving sets in beautifully polished boxes with ebonite tops; pretty little glowing valves and pretentious switches (but heaven only knows what is inside !) in order to satisfy their curiosity and "listen in." That curiosity is but natural. They are eager to hear what, after all, is a modern miracle. They can, with the expenditure of a few pounds, enjoy the results of twenty years of radio research, much of it patient and unproductive, as I know to my own cost, for in the early experiments in telephony upon low power for distance I worked daily for nine months without tangible result !

It is not the natural inquisitiveness that I criticise, but the amazing ignorance of so many amateurs all over the country—men who for several years have been "listening in" and have never taken the trouble to learn why their apparatus works, and who have never bothered themselves even to learn Morse. I fear that hardly fifty per cent. of our amateurs know anything of wave curve or time periods. Neither could they explain to a class the action of a hard valve, nor the real working of a crystal detector.

On the other hand I admit that some amateurs are really experts in radio. Certain amateurs whom I met before the war—one of whom I set up with his first crystal set—is now one of our greatest men in radio research -have really studied and become proficient in the technicalities of the science. But the majority, alas ! seem to content themselves with tuning in loud signals from GNI and others, and turning over the Hague concert into a loud speaker.

I agree that such proceeding means "radio for the public." But we want something more. Broadcasting is of course very interesting, but to the wireless amateur it should be far more interesting to be able to explain to his friends the function of every piece of his apparatus and so interest them in the real science of radio-telephony.

Dozens of amateurs have recently complained to me that all manufacturers assume that purchasers of their goods know all about them, hence there is a great difficulty in obtaining elementary instruction. This I admit, and only hope that some manufacturer will be enterprising enough to hold elementary classes at which radio could be taught like geography, and thus infuse into those who use receiving sets an enthusiasm for real and valuable research.

WILLIAM LE QUEUX.

Devonshire Club, S.W.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—It is somewhat surprising that the Government advisers for the new "Broadcast" stations have omitted Leeds as a centre; they can hardly be aware of its remarkable geographical situation for the purpose of broadcasting.

If you open a pair of compasses to the 80-mile scale on a Bartholomew map and strike a circle with Leeds as a centre, it will be found to embrace the *whole* of Yorkshire, Durham, Westmorland, part of Cumberland, the *whole* of Lancashire, part of Flintshire, the *whole* of Cheshire, greater part of Staffordshire and Leicestershire, the *whole* of Derbyshire, Nottinghamshire and nine-tenths of Lincolnshire; that is, it includes the most important commercial manufacturing, industrial, shipping and agricultural areas of the whole kingdom, besides a considerable area of the sea, off our East and West Coasts.

It would be almost impossible to find another centre embracing such a varied and wide diversity of interests within such a radius.

Is it presumptuous to ask "the powers that be" to consider these points ?

E.K.S.

# Book Reviews

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1922. (London: *The Wireless Press, Ltd.* Pp. 1477 + lxxxix. Price 15s. net.)

The 1922 edition of this annual is an excellent indication of the progress made in wireless telegraphy. The principal features of the book remain as in previous issues, but all sections have been carefully revised and enlarged so as to contain up-to-date information. The list of wireless stations of the world, both land and ship, shows a considerable expansion over the previous Year-Book. The Record of Development, which forms a distinctive feature, has been completed up to the date of publication, and the Laws and Regulations relating to wireless in all countries of the world has been revised and enlarged.

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Special articles by well-known wireless engineers again form a valuable feature, and in particular mention might be made of an article on the Recording of Wireless Signals, contributed by M. Henri Abraham, setting forth the different methods which have been made use of commercially for recording wireless signals, with special reference to high speed working.

In the section devoted to amateur and experimental wireless, an article appears which reviews the activities in the field of wireless from the point of view of the amateur and experimenter, whilst a big list of the experimental transmitting licences granted in the United Kingdom is included with particulars as to location, times of working, etc.

The list of patents records progress in invention and forms a comprehensive guide to what has been done during the past year.

At the end of the volume is included an entirely new feature which should prove of very considerable value and interest. This consists of a map of the world, specially drawn on great circle projection, with London as a centre, so that the correct direction and distance of any point in the world from London can be seen at a glance. This map will be found very valuable in estimating the relative distances of wireless stations heard in the London area, and the map is of course accurate for most practical purposes for a considerable range beyond the United Kingdom. This map is also of great value in connection with directional wireless.

The publishers have fortunately been able to reduce the price with this year's volume without in any way detracting from the general completeness and high standard of the annual.

RADIO QUESTIONS AND ANSWERS on Government Examination for Radio Operator's License. By Arthur R. Nilson. (New York: *McGraw-Hill Book Company, Inc.*).

This set of questions and answers is designed to cover the syllabus of the United States Government examination for wireless operators, and the subject appears to be well dealt with. The apparatus illustrated is exclusively American standard ship equipments, and the questions relating to Government regulations, traffic control, etc., are those operating in the United States.

Towards the end of the book a useful bibliography is included, classified according to the subjects dealt with in the volumes referred to.

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# Books Received

WIRELESS VALVE RECEIVER SET. How to Make It. By E. K. Spiegelhalter. (London: *E. & F. Spon, Ltd.* Pp. 79. 7″ × 5″. Illustrated. Price 3s. 6d. net.)

WIRELESS TELEGRAPHY AND TELEPHONY. By E. Redpath. (London: *Cassell & Company, Ltd.* Pp. 152. 7″ × 5″. Illustrated. Price 1s. 6d. net.)

THE A B C OF WIRELESS. A Popular Explanation. By Percy W. Harris. (London: *The Wireless Press, Ltd.* Pp. 64. 7″ × 5″. Illustrated. Price 6d. net.)

# Calendar of Current Events

**Saturday, June 10th.**

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.

Visit to Croydon Aerodrome.

**Sunday, June 11th.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, June 12th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7 *p.m.*—Committee meeting.

7.30 *p.m.*—Lecture by Mr. W. J. Featherstone.

**Tuesday, June 13th.**

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.

8 *p.m.*—"Electrical Terms and Their Meanings," by Mr. Blackmore, A.M.I.E.E.

Transmission of Telephony at 8 *p.m.* on 400 metres by **2MT** Writtle, near Chelmsford.

**Wednesday, June 14th.**

WIRELESS SOCIETY OF LONDON.

6 *p.m.*—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Address by Sir Oliver Lodge, F.R.S.

NORTH MIDDLESEX WIRELESS CLUB.

8 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Townsend Wavemeter and How to Use It," by Mr. L. C. Holton, followed by a Demonstration of the Reception of Telephony for Beginners.

**Thursday, June 15th.**

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Interpretation of Wireless Circuits," by Mr. F. E. Strudt.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, "Continuation of A.C. Experiments in Relation to W/T.," by Mr. E. F. Clarke.

**Friday, June 16th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part II, by Mr. J. Stanley.

BRADFORD WIRELESS SOCIETY.

Lecture by Mr. H. G. Evans.

**Sunday, June 18th.**

Transmission of Telephony from the Hague, **PCGG**, as above.

**Tuesday, June 20th.**

Transmission of Telephony from **2MT**.

**Thursday, June 22nd.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

Demonstration of the "Ultra IV" Receiver, by Mr. F. O. Read, Member I.R.E.

**Friday, June 23rd.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. Lecture and Demonstration. "The Construction of a Valve Receiving Set," (Part I), by Mr. F. L. Hogg.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Discussion on Direction Finding.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.*—[ED.]

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# Experimental Station Design*

*These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## II.—THE EARTH.

THE aerial circuit is completed by a connection to earth or alternatively to what is known as a "lower capacity." The more general and by far the easier method is the former and is accomplished by running a piece of stout copper wire, say No. 18 S.W.G., to a water main. The length of this lead should be kept as short as possible, and it must take the shortest route to the point of earthing. A small turn or loop in the earth wire is particularly detrimental when receiving on short wavelengths. Should the water main be located at some distance from the instruments an endeavour should be made to run an insulated wire kept some distance away from the wall or metallic conductors. If this is done the length of the earth lead adds to the receiving efficiency by acting as additional aerial for the picking up of energy from the strains in the aether. This applies particularly if the operating room is situated at the top of a house, when the earth lead should be taken out of the window and kept away from the wall, either by a strut with

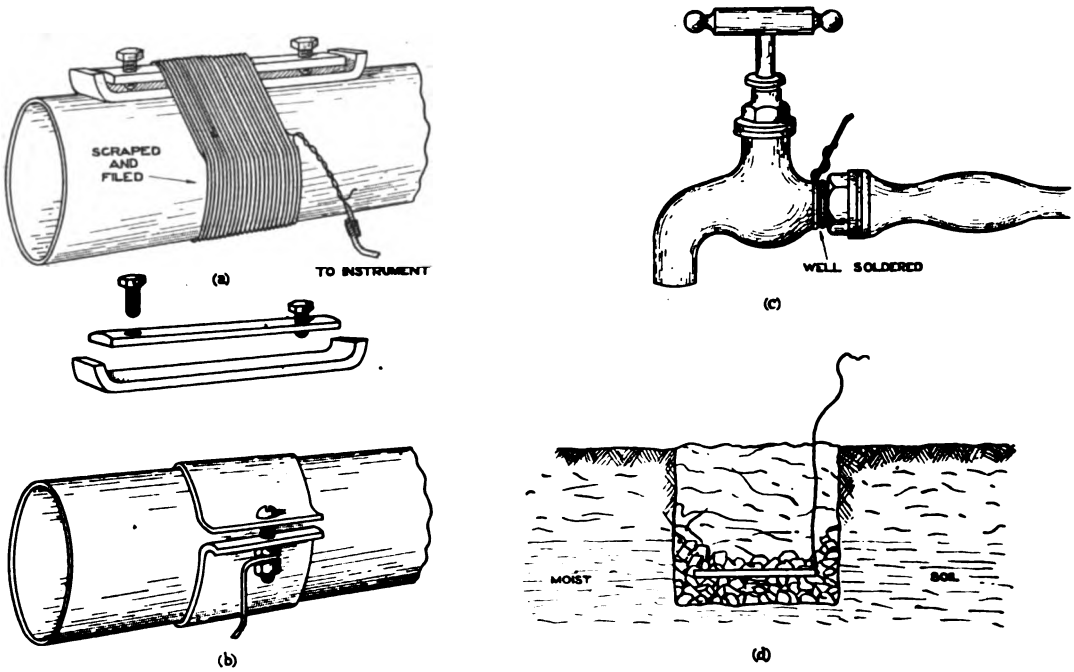


*Fig.* 1.

* The first article of this series, describing the construction of the aerial, will be found on page 259 of the issue of May 27th.

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insulators or by making the earthing point some distance from the house and running a taut slanting wire. The reason for this, is because the wave-lengths to which the receiver will tune depends upon the amount of wire in circuit in the aerial, instruments and earth lead, and should the earthing lead make contact with the earth on its way to the main point of earthing, the effective length of wire in circuit may be taken as a varying amount depending upon the point where the energy actually goes to earth. With short wave reception between 200 and 500 metres, small variations of the length of wire in circuit cause large changes in the wave-length to which the set is tuned and particularly is this the case when using an aerial of high capacity, such as one consisting of two wires and consequently the amount of wire in circuit must be definitely defined.

Various methods of making good electrical connection to water mains are shown in Fig. 1 (*a*) (*b*) and (*c*), and that embodying the use of two plates (*a*) with screw tightening is particularly recommended. Such an earthing clip can be seen on a telephone installation and is used for protecting the instruments from lightning and other high power electrical discharges, Before fixing any kind of clip, the pipe must be thoroughly cleaned either by scraping bright, if of lead, or by filing if it is of iron. Very reliable connection can be made by binding with clean copper wire and soldering, but this method is rather difficult unless a small blow lamp is available for raising the pipe to a sufficient temperature. A soldering iron is of very little use for the purpose, for the heat it slowly gives to the pipe is rapidly conducted away by the large amount of metal and the cold water. In using a pipe for earthing one must take the precaution of seeing that it is directly joined to the main and not through an intermediate cistern. If this is found to be the case the pipe may be used but a wire must also be run at the cistern, connecting the pipe to which connection has been made, across to the main supply pipe.

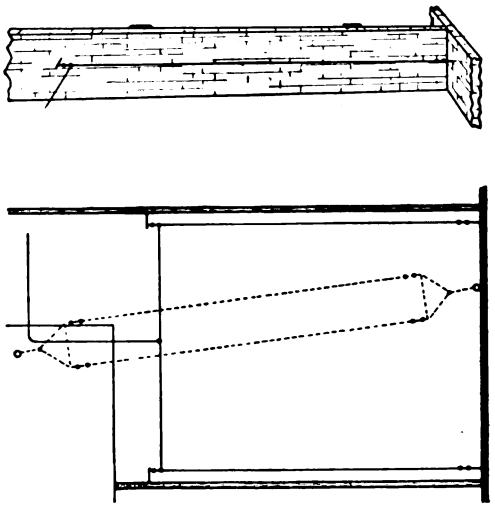

*Fig.* 2.

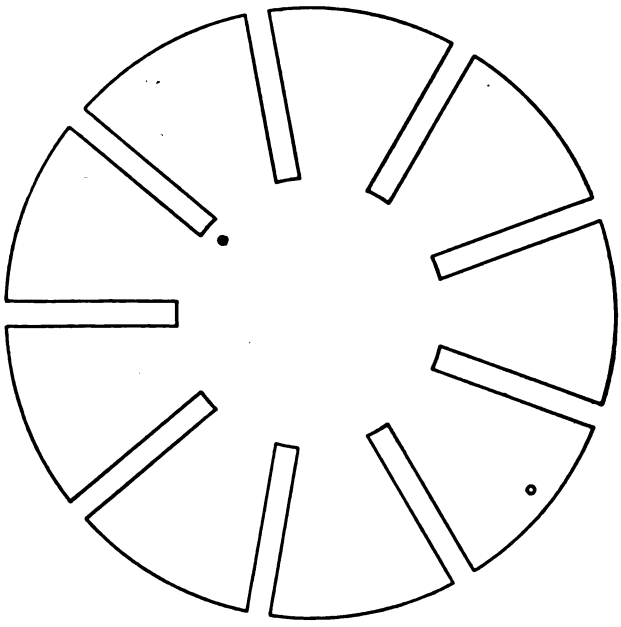

*Fig* 3.



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Where no water main exists a good earth can be made by running a wire to a number of buried metal plates. A diagram of one of these plates is given in Fig. 1(*d*). A hole must be driven, if possible, down to wet soil, and thoroughly packed round with good clean coke. The plates may be of zinc, copper or even galvanised iron and the lead must make perfect electrical contact. The wire may be bolted to the plate to hold it mechanically and then soldered. For economy the earthing plates may consist of discarded galvanised iron household utensils, such as baths, dustbins, etc., but if so, the utmost care must be exercised to ensure that a good soldered joint is made to them. The plate is completely surrounded with coke before putting back the soil. Leads to the buried plate should not be of less gauge than No. 18 owing to their liability to damage and corrosion. If the soil is moist one plate 2 feet square will be sufficient, but in cases where it is dry several plates must be buried, spaced apart and connected together by wires of as near as possible equal length, the actual lead to the instruments being taken from the point where the plate wires join together. Where the soil is very dry, such as in gravel or sandy districts, what is known as a "lower capacity" may be found to give better results. This arrangement is shown in Fig. 2, and consists of two or more wires according to convenience, insulated and run beneath the aerial. The same class of wire of which the aerial is made should be used, and the same precautions taken with regard to ensuring good insulation. The lead in to the instruments may be of the same type as that used for bringing in the aerial wire. The diagram shows the wires attached to walls and this will be found particularly convenient as it offers support and protection. When a lower capacity consists of several wires they must all be equal in length and may either radiate out from a point in several directions or be arranged parallel to each other and the aerial. These instructions may seem elaborate but a reliable earthing system very materially adds to the efficiency and range of the station.

### III.—SHORT WAVE TUNERS (150 to 450 metres).

The two designs given are of tuners specially suitable for the receptions of broadcasted telephony. In view of their simplicity it must not be thought that they are in any way inefficient or inferior to more elaborate designs and especially are they applicable when crystal detectors are employed. Even the experimenter, already in possession of an elaborate station, is well advised to make up a special set for the reception of broadcast in order that he may still pursue his experiments and yet always have a set in readiness to receive the short wave telephony. A simple tuner connected to a crystal detector can always be relied upon for telephony reception because it requires no batteries and portability may prove to be of advantage.

Many difficulties present themselves in the construction of tuners for short wavelengths, the greatest being due to the fact that the small amount of wire necessary to add in the aerial circuit for tuning, does not readily lend itself to the operation of

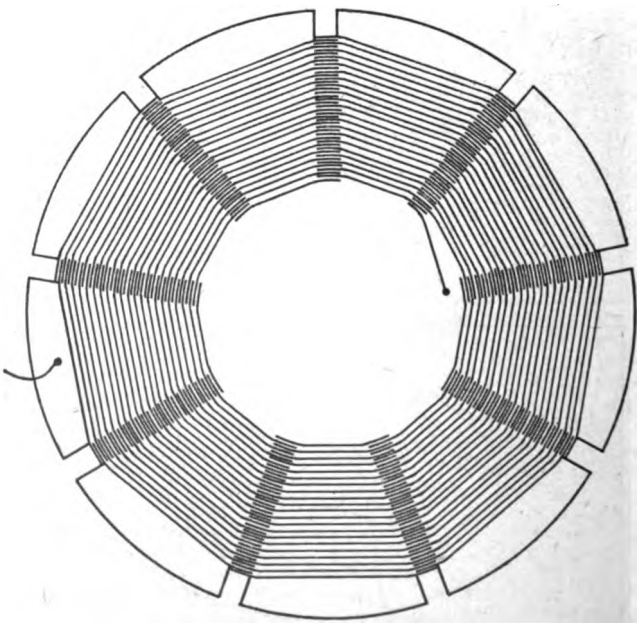

*Fig.* 4.

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detecting devices. A very important detail in the reception of telephony is fine tuning adjustment. This is often achieved by the use of a variable condenser, but is by no means necessary, and apart from adding to the complications of the outfit, may even prove to be inefficient, and although sharp tuning is gained by its use, the loss of energy caused by the condenser may reduce the signal strength as compared with alternative methods.

The inductances in the first design consist of stiff cards wound with No. 28 single cotton covered wire or double silk-covered wire. In purchasing the wire, a quarter of a pound will be found ample and will leave enough over for connecting up and experimenting. The cards, not so tight that it distorts the card and bends it up basket-like. Correctly wound, the wire mentioned above will give about 44 turns, or as viewed from one side, 22. The finishing end is taken through a hole on the edge of one of the segments. The wire should be taken through cautiously to avoid tearing the card and bent back to keep the tension. Two such inductances are required. The wound cards are then placed in a moderately warm oven to drive out any minute traces of moisture the wire or cards may hav acquired during winding. After this they should be transferred to a bath of melted paraffin wax. They should be left in the wax during coolin until there is a sign that the wax is going to set

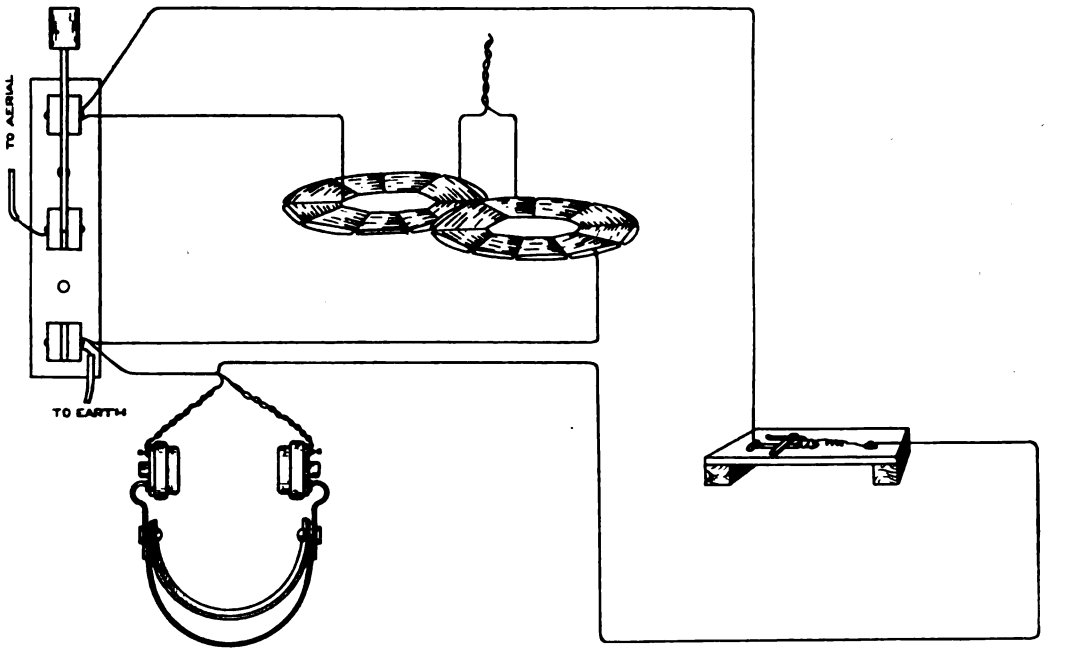


*Fig.* 5.

which may be made from ordinary postcards, must be very carefully cut to the exact dimensions shown in Fig. 3. This can be done by placing a postcard beneath the diagram and carefully pricking through at all corners. In cutting the slots great care must be taken that cuts are not made beyond the depth shown, or otherwise the segments produced by the cuts will become so weak that they are apt to break off when winding is commenced. Should one slot have been made, by accident, a little too deep the card should not be used, for the wire falling deeply into that slot will not build up evenly during winding. Winding is a simple process and requires little explanation. A glance at Fig. 4 showing a completed inductance will be sufficient. In passing the wire through the centre hole it should be sharply bent back to prevent it pulling through when beginning to wind. Pull the wire tightly during winding, but and then removed, pressed between two smooth flat boards and allowed to set hard.

The two coils connected in series as shown in Fig. 5 constitute the tuner. When placed over one another in one direction their magnetic fields oppose and their inductive values are very low, but when one is reversed the magnetic fields assist each other and the inductive effect is at a maximum, and by sliding them relative to one another intermediate values are obtained.

Another type of tuner which has gained a good deal of popularity in America for short wave crystal reception is that in which the inductance is wound on a cardboard or ebonite tube and connections taken from the wire to studded switches. Such a tuner may be more expensive to make, but possesses the advantage of giving a tuning adjustment that can easily be noted, and the switches can readily be set for the particular reception

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desired. As this is the only advantage gained by a more complicated arrangement, a brief description will suffice. For anyone making up this class of tuner with purchased switches, a good former on which to wind the wire is the small cardboard cylindrical box such as is used for packing upright gas mantles. This has an approximate external diameter of 1⅝ in., and should be carefully wound with 90 turns of No. 26 double cotton-covered wire. It is necessary to dry out the cylinder by placing it in a warm oven before winding, as any subsequent drying will reduce the diameter and slacken the turns of wire. It should be treated in the same way as the inductances described above with regard to insulating by immersion in paraffin wax. Two ten-stud switches are suitable for varying the tuning and tappings must be made from every turn for the first ten turns, and on every ninth turn for the remainder. These tappings are made by tightly twisting up a short length of the wire as it is put on, leaving about 1½" of twisted wire projecting for connecting up to the switches. Tappings stepping off nine turns are taken to one switch in order, and the single turn tappings are taken to the other switch. The two switch arms are the two terminals of the tuner. One switch will of course, provide for rough tuning, and the other having single turns of wire between its studs effect fine adjustment.

## IV.—CRYSTAL DETECTOR.

One very simple form of crystal detector is that using contact between a piece of silicon and an iron wire. All that is required is a device to hold the crystal in position on a base to which is fixed the wire in the form of an easily bendable spiral and the actual construction of so simple a piece of apparatus can be left to the reader in order that he may make use of any fitments he may have to hand. Fig. 6 shows one way of making up this detector. It consists of a small base-board measuring 1½ins. by 2½ ins, which, in order to improve its insulating properties has been dried and immersed in melted paraffin wax. Struts connected across the bottom will serve to prevent warping,

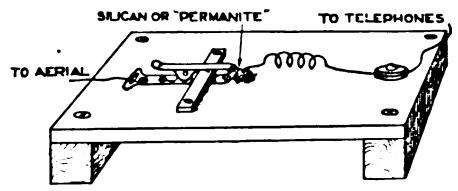


*Fig. 6.*

and also to keep the points of the screws driven into the top coming into contact with the table. A tie-clip is used for gripping the piece of silicon, and is held down securely by screws one of which may also be used as a terminal by twisting a piece of wire beneath it. The iron wire, bent into the shape shown in the diagram and held in position by a screw, is the other terminal, and carries a lead for connecting up.

There are many types of crystal detectors on the market, and for those who wish to purchase one, the perikon type can be well recommended. It may consist of a contact between zincite, a reddish looking substance, and copper pyrties, which has a greenish-yellow metallic appearance. Perikon is one of the most sensitive of detectors, and is easy to adjust as it requires a fairly heavy pressure when correctly set. Another type which is in general use is that consisting of a contact between a piece of carborundum and a steel spring. This kind of detector requires additional apparatus to render it sensitive, but is found incorporated in many well-known sets because of its remarkable stability.

## V.—CIRCUIT AND OPERATION.

The method of connecting up the two slab inductances first described and the detector and telephones to the aerial and earth connections is seen on further reference to Fig. 5. Care must be taken to keep all leads away from one another and from contact with anything liable to reduce the insulation of the set. Terminals where fitted for convenience should be amply spaced. The telephone receivers must be of high-grade manufacture and only those of well-known makes should be adopted. Too much stress cannot be put upon the necessity for the use of efficient receivers, and this particularly applies when using a crystal detector. Each ear-piece should be wound to a resistance of from 2,000 to 4,000 ohms.

For operating the set the use of a buzzer for testing the sensitiveness of the crystal and ensure its correct setting, is practically essential, and a buzzer incorporated in a wavemeter, that is an instrument which will transmit feeble oscillations on a definite wavelength, is particularly useful, and the construction of such an instrument will be given in the next of this series of articles.

The tuning of the set is effected by moving the coils over one another, and their relative position controls the wavelength.

F.H.H.

# Weather Forecasts for Farmers.

## HOW AND WHERE TO OBTAIN THEM.

Weather forecasts for farmers are issued by the Meteorological Office, Air Ministry, Kingsway, London, W.C.2, during the hay and corn harvesting as follows:—

REGULAR FORECASTS.—These are for the farmer who desires to have weather information daily. They can be telegraphed in the early morning, in the middle of the day, or about tea-time. They cover the next 24 hours. No charge is made except a registration fee of 1s., and the Post Office charge for telegraphy (the average cost of which is 1s. 3d. per message). Whenever a few days' settled weather is seen approaching, a message is sent out informing subscribers of the fact. A small charge of 6d. per message is made in this case in addition to the cost of the telegram. Full particulars will be supplied on application to the Director of the Meteorological Office, but forecasts will be sent on receipt of a request and a sum either in the form of a deposit of 7s. 6d. or sufficient to cover the total cost of the message asked for.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Ilford and District Radio Society.

At an informal meeting held on Thursday, May 18th, a somewhat novel procedure was adopted. The Chair was taken by the Secretary who, working in alphabetical order, called upon each member of the Society in turn to draw on the blackboard and explain the circuit he had adopted for reception at home.

Several of the newer members were at first a little embarrassed, but after a time confidence came, and many useful and novel circuits were shown, some of them for the first time. Naturally, there were a few of the standard self-heterodyne single valve circuits, but the majority were something more powerful.

The tuned anode—crystal rectification—circuit is apparently still the most popular, but it seems to be steadily losing ground to the reactance capacity circuit advocated by Commander Phillips in a recent discussion of the Wireless Society of London. This circuit with an additional high frequency valve coupled in a somewhat peculiar manner was given by Mr. A. E. Gregory, and the same member also submitted as a basis for experiment, a useful circuit for very short wave reception. An excellent idea was that of Mr. J. F. Payne, who uses two degrees of high frequency amplification before rectifying, the couplings being on the "plug-in" system. Different methods of coupling such as transformer, resistance capacity, reactance capacity or choke, are mounted on four-pin plugs, and thus without any complicated switching arrangements any method can be employed. Mr. F. C. Grover intimated that he was also using this circuit.

Probably the most useful circuit for Ilford—where nearly every house has D.C. mains laid on—was a device for using the mains as high tension supply, given by Mr. L. Vizard, where, by means of two carbons rotating, in a jar filled with water, between two others, any voltage from practically nothing up to the full two hundred, can be obtained according to the distance between the two sets of electrodes.

On Thursday, May 25th, the last meeting of our first year, Mr. L. Vizard lectured on "Continuous Wave and Telephony Transmission."

The excessively hot weather made lecturing extremely difficult but Mr. Vizard managed very well with the material at his disposal. He described briefly the struggles of the early pioneers with their attempts at modulating damped wave transmission by speech frequencies, and explained the great improvements that arose when the Poulsen arc system of continuous wave generation was discovered. The lecturer illustrated how a valve generates continuous oscillations, giving one or two simple circuits, and explained the principle of keying.

The next step in the evolution of the present-day radio-telephony transmitter was the use of a microphone for modulating the continuous stream of oscillations. Many different methods have been tried, such as inserting the microphone directly in the earth lead or coupling it to the A.T.I., but all these methods failed when used with high powers. A step-up transformer improved matters, and it was found that by using a microphone for varying the grid potential, large variations in plate current could be obtained. This method, known as grid control, is still largely used for short wave work. After reference to the choke control system, Mr. Vizard gave several useful circuits for experimenting with for obtaining quiescence, so that there is no radiation and consequent waste of power except when one is actually speaking. This would obviate the continuous carrier wave, the cause of so much interference. In conclusion he gave us a very interesting description of his own station, **2JX**, which is no doubt familiar to the majority of London amateurs.

Hon. Secretary, Mr. L. Vizard, 12, Seymour Gardens, Ilford.

### Wireless and Experimental Association.*

A meeting of the above Association was held on Wednesday, May 17th, at the Central Hall, Peckham.

Various types of aerials were discussed, it being pointed out that a vertical wire should be ideal for transmission and reception, but that the nearest practical type of aerial would be the single wire kept as high as possible.

Suggestion was put forward by a member that a distinctive badge be worn, and the matter was held over for a committee meeting.

Preliminary arrangements were made for organising a public demonstration on wireless, and a committee was appointed to enquire into ways and means, and compile a working scheme to fulfil the requirements. Two candidates were admitted to membership, and we are looking forward to a big increase so as to more than maintain the reputation of being a decidedly live organisation. Special arrangements are being made for new members, especially beginners, who are invited to attend any of our meetings.

The meeting held on Wednesday, May 24th, at the Central Hall, Peckham, was, in the opening half, taken up by a discussion on the broadness of tuning when receiving telephony transmissions. The original query was, whether that effect were due to the amplitude of the modulation or to some other effect. The broadness of tuning of the transmissions of well-known stations affords an example, and the suggestion was put forward that it might be an effect due to the percentage modulation of the carrier wave. A very interesting half-hour was spent going well into this question, but there is still some more to be brought forward next week. The second half of the evening was an agreeable surprise as a four-valve unit panel receiver had been installed on the gallery of the main hall. Members

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were invited in turn to try their methods of tuning in, and many points were noticed regarding the peculiarities of the set in question. Music sent out by **2FQ** was received remarkably well on about 900 metres, provided the aerial inductance switch were making contact with two studs.

This was a good example of freak tuning. When the music stopped, the member listening in, reported that it had given place to Morse. On investigation, this proved to be friend **GBL**, and various comments were passed regarding the question of mistaken identity. Finding the meeting had overstepped its tune by half-an-hour, the meeting closed at 10.30 p.m. Prospective members are requested to communicate with the Assistant Secretary (Walter J. Joughin), 21, Troughton Road, Charlton, S.E.7.

### Bradford Wireless Society.*

A meeting was held in the clubroom at 7.45 p.m. on Friday, May 19th, with Mr. W. C. Ramshaw in the chair. The minutes of the last meeting were read by the Secretary, following which a few new members were elected. The Chairman then called upon Mr. Whiteley to give his paper on "Radio Traffic and its Handling." In a very clear manner the methods of handling traffic were described and the lecture concluded with a demonstration of ship and shore working, in which the buzzer representing the ship station was operated by Mr. Burgess and the shore station by the lecturer himself. At the conclusion a hearty vote of thanks was passed.

Following the lecture a general discussion on the reception of short waves was opened, which was very much enjoyed by those present.

Please note that our Secretary, Mr. J. Bever, has now returned and that all communications regarding membership, etc., should be addressed to him.

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

### Southampton and District Wireless Society.*

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A General Meeting of the above Society was held at its headquarters on Wednesday last, May 17th, a good attendance of members made an enjoyable evening. The discussion for the evening (variable and fixed condensers) following various makes of valves, which was loaned by Mr. Stockdale for the occasion, proved very interesting. It was announced at the conclusion of the discussion that a public demonstration would be given on the following Wednesday. A Burndept Ultra IV, kindly loaned by the Crays Installations, and demonstrated by Capt. Young, A.M.I.E.E., was to be used for the occasion, and an interesting evening is being looked forward to.

### The Wireless Society of East Dorsetshire.

Hon. Secretary, Mr. E. T. Chapman, Associate I.R.E., Abbotsford, Poole.

A meeting with an elementary lecture on receiving circuits and apparatus was held in the Wimborne School, on May 18th.

The new concession of the Postmaster-General, *vide* speech by Sir Henry Norman in the House of Commons on May 4th, of unrestricted lengths of receiving aerials was exploited, but found to be of little advantage in view of the short wavelengths to be used by broadcasting stations, although there were several appreciable advantages.

An aerial is to be erected at the Wimborne School and members wishing to try their apparatus will be able to do so on meeting nights.

Members and enthusiasts in the Poole, Parkstone and Branksome districts are informed that a special meeting and demonstration will be held in Branksome Liberal Club (headquarters *pro tem.*), on Thursday, June 1st.

Further particulars from the Secretary who will be pleased to receive prospective members at Serpentine Road.

### Romford Wireless Society.

Hon. Secretary, Dr. E. H. Chapman, 32, Meadway, Gidea Park, Romford.

The Romford Wireless and Scientific Society has recently been established in connection with the Red Triangle Community Centre, North Street, Romford. The Society has its headquarters at the Community Centre and masts for a twin aerial have already been erected. It is hoped to install an elaborate set of instruments for reception of wireless concerts in the near future. Morse code classes are in being, and are meeting weekly. During the summer months the Society will prepare for a big winter programme of technical classes and popular concerts. The enthusiasm of the initial members is well shown by the well-planned wireless exhibition and demonstration to be given at the Romford Sports and Fete on Whit-Monday.

Officers elected:—President, Major Castellan; Chairman, Mr. T. England; Hon. Secretary, Mr. E. H. Chapman, M.A., D.Sc.; Hon. Treasurer, Mr. H. Bristowe; Assistant Hon. Secretary and Treasurer, Mr. W. Evans.

A limited number of new members will shortly be elected. New members possessing working sets will be especially welcome.

### Liverpool Wireless Society.

A meeting of the Liverpool Wireless Society was held at the Royal Institution, Colquit Street, on May 11th last, when Messrs. Robinson and Forshaw gave us the benefit of a very pleasant evening and demonstration in recording. Signals were received by Mr. Robinson on his apparatus, and were recorded by Mr. Forshaw by means of his relay and recorder. Carnarvon and similar high speed stations being successfully copied.

Mr. Coulton presided and proposed a hearty vote of thanks, which was carried with applause.

An attempt was made to get the *Daily Mail* broadcast of the fight result, but although a few words were heard, nothing satisfactory was received.

A special meeting of the Committee was held on May 23rd last, and it was decided that junior members under the age of 18 be admitted half-price, *i.e.*, 5s. This was also to apply to apprentices serving their time up to 21 and under certain circumstances, students.

It was also decided, in view of the great advance in amateur wireless, to recommend the members to pass a resolution to the effect that the Society remain open through the three months we generally close down. This was done, and we hope all the members will support us in the matter.

It was also decided that half-an-hour before every meeting there should be a lecture for beginners who know little or nothing about wireless. This meeting will take place therefore every evening before the main lecture, namely, at 7.30.

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On May 24th the Society met and decided to postpone the meeting of June 1st until June 8th, in view of the sudden change in the programme for the summer months.

The Chairman, Mr. Grindrod, then introduced Dr. S. S. Richardson, who read a paper entitled "Some Things Worth Trying," and illustrated his remarks with numerous drawings.

This was much appreciated, and a vote of thanks was carried with applause. The evening concluded with a musical demonstration received by Mr. Lowey on his splendid home-made set, which was greatly appreciated by everyone.

Hon. Secretary, James K. Wilkie, "Avondale," Knowsley Road, Cressington Park, Liverpool.

### Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

During the past two months several interesting lectures have been given by Mr. L. Grinstead and Mr. F. L. Hogg, and also an excellent demonstration of transmitting and receiving apparatus by Lieut. H. Walker. The Society's three-valve receiving set is now completed and is giving excellent results.

A series of elementary theoretical and constructional lectures and demonstrations have been arranged, the theoretical side being undertaken by Mr. J. Stanley, and the constructional side by Mr. F. L. Hogg, and one or two other lectures on special aspects of wireless theory and construction by other speakers will also be included in the series. These lectures will commence on Friday, June 9th, and we invite all amateurs in the district who are interested to be present at the first lecture of the series.

A field day has been arranged for June 24th, and it is hoped that permission will be obtained to hold this in Ken Wood. A licence for a portable transmitting and receiving set is being applied for for this occasion.

An advisory committee has been instituted, consisting of experienced members of the Society, to advise and help members who are in any difficulties with their sets.

The Secretary will be very pleased to receive enquiries regarding the Society from amateurs or others interested in wireless matters in Highgate or the surrounding districts, and to give further particulars of the lectures now being arranged.

### The Willesdon Wireless Society.*

Enquiries for membership, etc., to Mr. F. A. Tuck, 87, Mayo Road, Willesden, N.W.10.

The Society met on the 23rd at their Headquarters, 25, Station Road, Willesden Junction, N.W.10, when an open meeting was held, Mr. W. Corsham giving an impromptu lecture upon short wave reception until the lecturer for the evening Mr. C. Dunham, arrived with his gear, consisting of a four-valve receiver, one H.F., one rectifier and two low frequency, a crystal set being also included in the same box. Several new members were present, and despite the heat, the attendance was fairly good. The meeting closed at 10.30 p.m.

### The West London Wireless and Experimental Association.*

Club-rooms, Belmont Road Schools, Chiswick, W.4.

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

Meeting held Thursday evening, May 18th. A very well attended meeting listened to our Vice-President, Mr. F. E. Studt, who gave a very interesting paper on the Reinartz Tuner. He also exhibited one that he had constructed for the purpose of his lecture, and great interest was taken in the small details which were so fully and ably explained.

A very hearty vote of thanks was accorded the lecturer when he had concluded.

It is undoubtedly encouraging to the various amateur societies and associations to see the great strides about to be taken in the science of wireless telephony, and applications for membership to these will no doubt pour in thick and fast now the P.M.G. has withdrawn many of the restriction which somewhat tied the hands of the would-be experimenter, and it is sincerely hoped that now with more liberty the amateur experimenters will make it a special business to see that they do not take any liberties with the concessions now or shortly to be placed in their way.

### Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A General Meeting of the above Association was held on Thursday evening, May 11th, Room 74, Mechanics Institute, Nottingham.

Mr. D. F. Robinson provided the bill of fare on this occasion when he demonstrated his five-valve amplifier set. Mr. Robinson gave a detailed explanation of all the component parts, and the way in which the set was constructed was very creditable indeed. An indoor aerial was erected, but unfortunately no signals were obtained, with the exception of one ship, which was very weak. We put this failure down to the fact that our room is greatly surrounded by buildings and the maze of telephone wires which exist round the Mechanics Hall. In view, therefore, of the failure, we made the best of a bad job, and listened intently to Mr. Robinson's explanations of his set.

Particulars of the Association may be had on application to the Secretary.

### Hounslow and District Wireless Society.*

The above Society continues to make good progress and in view of the boom in the press on broadcasting, we hope to do better. At the last meeting, on May 18th, a very interesting lecture was given by Mr. Gordon Fryer, L.D.S., R.C.S.Engl., our Vice-Chairman, entitled "The Elementary Theory of the Valve." Mr. Fryer delivered his lecture in a very able manner, showing he knew his subject well. We hope to have more papers of this kind in the future.

Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow.

### The Sussex Wireless Research Society* and The Brighton Radio Society.*

Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton.

At a recent joint meeting of the above Societies, a most interesting paper was read by Mr. W. E. Dingle, President of the Brighton Radio Society, entitled "The Construction of a Submarine Cable," during the course of which the lecturer described the various processes and shops through which such a cable must pass before it is ultimately consigned to the bed of the ocean where it is re-

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quired to fulfil its duty as a link of communication between this and distant countries for many years. Specimens of submarine cables kindly loaned by Messrs. Siemens, Bros. & Co., Ltd., of Woolwich, were passed to the members for inspection. These included a portion of the first Atlantic Cable which was successfully laid in August, 1858.

At the close of the lecture a short discussion ensued and Captain E. A. Hoghton concluded a very pleasant evening by proposing a vote of thanks to the lecturer. This was seconded by Mr. James Cowie and carried unanimously.

The ever-increasing popularity of Wireless in the vicinity of Brighton is well marked by the good attendance at these Societies' meetings, and it is pleasing to note that fresh faces join the throng at every meeting.

### The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

At the meeting of the Society held on May 25th, Mr. F. Corfield lectured the members on the "Construction and Maintenance of Primary and Secondary Batteries." The lecture was well received and a hearty vote of thanks was passed to the speaker.

The usual "Question and Answer" period was opened after the lecture; many questions regarding wireless and kindred subjects being asked and answered by the members present.

This item will be included in the agenda of every meeting, and all members are invited to submit their troubles and difficulties to the Society.

It is intended to hold field meetings shortly, and the Hon. Secretary will be pleased to receive suggestions.

### Wolverhampton and District Wireless Society.

A General Meeting of the above-named Society was held at 26, King Street, Wolverhampton, on Tuesday evening, May 23rd. After buzzer practice, at 8 o'clock, a lecture was delivered by Mr. Blakemore, A.M.I.E.E., on "The Thermionic Valve." The lecturer, who is very thorough and painstaking, illustrated his remarks by means of vacuum tubes and special drawings, giving the members much food for thought. This lecture was the second of three by Mr. Blakemore, which the Society have been fortunate in booking. The third will be "Electrical Terms and their Meanings," and will be delivered after buzzer practice on Tuesday, June 13th, at 8 p.m. not June 6th, as previously announced. Will members please note Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

### Sutton and District Wireless Society.

A meeting of the Society is held every Thursday (8.0 p.m.) at the Adult School, Benhill Avenue, Sutton, and all who are interested are invited to come along. The entrance fee is 2s. 6d. with a 10s. annual subscription.

At the meeting on Thursday, 25th inst., one of the members, Mr. W. H. Norvill, gave a paper on "The Theory and Operation of the Valve."

As soon as we get our licence down we hope to start work in earnest.

Hon. Secretary, Mr. E. A. Pywell, "Stanley Lodge," Rosebery Road Cheam, Surrey.

### Walthamstow Amateur Radio Club.

Hon. Secretary, Mr. R. H. Cook, 49, Ulverston Road, E.17.

The above Club is held at the Y.M.C.A., Church Hill, every Wednesday, at 7.30 p.m.

A programme has been arranged as follows:—7.30-8, free discussion; 8-8.30, club business and buzzer practice; 8.30, lecture followed by listening in.

On Wednesday, May 24th, the Hon. Secretary gave a lecture on "Electrical Measuring Instruments," and he has been requested to continue on the subject at an early opportunity.

The Club has decided to help at local fêtes, etc., by giving wireless exhibitions, and as they are able to receive very good telephony it will no doubt prove a success.

Recently our members wanted to dance to the music, but owing to the room being very full they had to give it up.

The Club will be pleased to welcome new members.

### Pontypridd and District Wireless Society.

An Inaugural Meeting was held on Thursday, May 25th, at the Y.M.C.A., Pontypridd, when it was unanimously decided to form a society under the above name. The following officers were elected to hold office for 12 months:—President, G. J. Evans, Esq.; Vice-President, Mr. Billing; Hon. Secretary and Treasurer, Mr. D. V. Briggs; Committee, Messrs. J. Reilly, E. C. Bayliss, Dan Davies, W. James, N. Nevies.

It was decided to hold meetings on Tuesday evenings, that day being the most suitable. Any persons interested and needing further particulars may obtain same from Hon. Secretary and Treasurer, 5, Llwynmadoc Street, Pontypridd, Glam.

### The Newport I.W., Carisbrooke and District Radio Society.

A wireless society has been formed with a membership of well over 30, and the following officials have been appointed:—President, the Rev. W. H. Mackinnon: Vice-Presidents, Messrs. E. Munden (Mayor of Newport, I.W.), S. J. Jackson (Postmaster), T. Turley, and J. H. Linington; Hon. Secretary, Mr. S. O. Feben: Treasurer, Miss E. Read; Committee, Messrs. G. S. Harris (Chairman), L. Norman, A. Long, Fry and Tyler; Auditors, Mr. G. Yelf and Mr. L. F. Salter.

The Hon. Secretary's address is Meadowside, Priory Road, Carisbrooke, and he will be pleased to hear from any intending members. Steps are being taken to affiliate to the Wireless Society of London.

In connection with this Society an interesting lecture was given by Mr. L. Norman on "Crystal Sets and their Construction," May 3rd.

With the aid of diagrams he clearly explained the construction and advocated the use of either carborundum or zincite-bornite for best results. Of the sensitive forms of crystals he considered "Permanite" as the most constant. The lecture was thoroughly enjoyed by the members, and questions were asked and ably answered.

On a proposition by Mr. J. H. Linington, the Chairman, a hearty vote of thanks was accorded to the lecturer, which was duly seconded and carried with acclamation.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"D.R." (Doncaster)** *refers to reply given to* **"INTERESTED" (Walford),** *page 59, April 8th issue, and asks* (1) *For diagram showing the connection of parts recommended.* (2) *The values of grid condenser and leak.* (3) *For the name of a practical book on wireless.*

(1) The apparatus may be arranged as shown in diagram (Fig. 1). (2) The best values depend upon the type of valve used, but the following will generally be satisfactory: grid condenser 0·0003 mfd. and leak 2 megohms. (3) "The Construction of Amateur Valve Stations," by Alan Douglas (1s. 6d.), The Wireless Press.

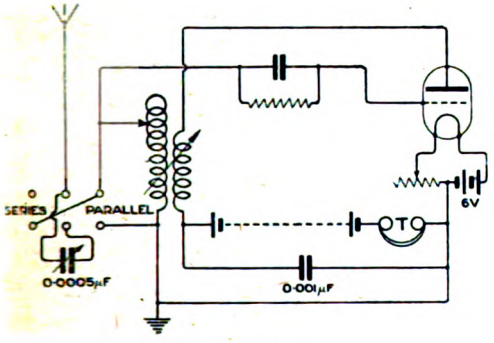


*Fig. 1.*

**"E.R.B.R." (Birmingham)** *asks questions regarding a crystal set.*

Both your diagrams are incorrect. Arrange circuit as shown in Fig. 3, page 60, April 8th issue. You will then probably hear **2MT** and Croydon weakly. A stage of H.F. magnification will greatly increase the usefulness, as shown in Fig. 4, page 61, of the same issue, in which use is made of the crystal, as shown in diagram given to **"D.R." (Doncaster)**, above.

**"H.E." (Newark)** *asks* (1) *Whether to add a H.F. or L.F. magnifying valve to an existing set, which consists of valve magnifier with crystal detector.* (2) *If reactance capacity coupling may be used.* (3) *Amount of wire to wind on telephone transformer to convert to an intervalve one.*

(1) It will be easiest and probably most effective to add a L.F. magnifier. Connect primary of inter-valve transformer to existing telephone terminals and secondary to grid and negative side of filament. (2) Yes, if a H.F. valve is added this method of coupling may be tried. (3) About 4 ozs. of No. 44 S.W.S. wire will be required.

**"J.A." (Lydd)** *asks questions regarding a single-valve set.*

The circuit shown in your diagram will not be very good for telephony unless you can manage to insert a reaction coil. If the A.T.I. is solid, make a reaction coil to slide over it. The grid condenser should be 0·0003 mfd. A variable condenser in the aerial circuit will be a great improvement and is necessary for fine tuning.

**"D.R.E." (Sheffield)** *refers to reply to* **"H.C.S." (Putney),** *page 709, February 4th issue, and asks* (1) *Capacity of variable condenser to use with windings given.* (2) *Which would give the better results on 30 volts H.T., "R" valves or "Ora."* (3) *Resistance of Brown telephones to use with telephone transformer.* (4) *Best direction of aerial.*

(1) 0·0005 mfds. (2) The "Ora" valves will probably be more suitable for use with 30 volts. (3) 120 ohm total resistance. (4) Your diagram gives no information to guide us. There appears to be no reason why it should not run in either direction.

**"T.L.A." (Acton)** *has a single-valve set which does not give satisfactory results.*

No particulars of set are given, so that we cannot say if properly proportioned. The grid leak is rather high at 2 megohms, and we suspect this is the cause of the trouble. The hum is caused by induction from lighting mains, and is usually heard when there is a break in the grid circuit. Try a new leak. Connect a 0·001 mfd. condenser across the 4,000 ohm transformer winding in the anode circuit. The aerial should be satisfactory.

**"F.E.W." (Hampstead)** *asks* (1) *If sample of wire is suitable for aerial.* (2) *Issues in which single-valve set is required.*

(1) This will not be very suitable, because it is a copper wire surrounded by a number of strands of iron wire. The presence of this would greatly increase the losses in the copper aerial. (2) February 5th, March 5th and 19th, 1921 issues.

**"C.E.L." (Finchley)** *asks questions regarding crystal set.*

No. 30 wire is much too fine for a crystal set aerial circuit. Re-wind the former with No. 24 wire. The maximum wavelength will then be

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about 3,000 metres. The circuit shown is correct, except that the crystal battery is not right. The correct connection of a potentiometer is shown in Fig. 2, page 59, April 8th issue. The variable condenser might be 0·0003 mfd. For telephone transformer use about 6 ozs. of No. 36 wire for the primary and 6 ozs. of No. 32 for the telephone winding. You should hear ship stations Eiffel Tower and 2MT and Croydon telephony.

**"C.F.H.C." (Surbiton).**—Steel wire is useless for aerials. Use copper. Brown's 4,000 ohm telephones do not require a transformer. Condensers made of tinfoil or copper coil are equally efficient, and have equal capacity for same number of plates and thickness of dielectric, but tinfoil is very fragile.

**"F.A.L.S." (Alton)** *refers to "Work" 5-valve amplifier, and asks if 120 ohm telephones may be used without structural alterations.*

If this set has a telephone transformer these telephones may be used, otherwise an external one must be provided.

**"BERTIE CLAQUE" (I.O.M.)** *asks* (1) *If aerial shown will do for valve sets.* (2) *Can "R" valves be used for H.F. magnifier.* (3) *Will a single-valve set receive Marconi Concerts.* (4) *Is circuit shown suitable.*

(1) This seems a very poor aerial. For effective work it should be made considerably longer and the end farthest from the house raised. (2) Yes. (3) With a carefully designed set and a larger aerial you might possibly just hear it. You will probably hear the Harbour telephone set at Liverpool. (4) Yes, if a 0·001 mfd. condenser is connected across the telephones.

**"A.H." (Gospel Oak)** *asks for a crystal diagram, using two-slide tuning inductance and condenser.*

Arrange apparatus as shown in diagram given to **"L.H." (Mansfield)** opposite. This also shows how a L.F. valve magnifier may be added.

**"CURIOUS" (Manchester)** *asks* (1) *and* (2) *About using Sac Leclanche or Daniell cells for lighting one valve filament.* (3) *What days and times does* **PCGG** *transmit telephony.*

(1) and (2) A continuous discharger of 0·7 ampere is rather heavy for this type of cell. We do not advise their use except for H.T. batteries. (3) Regular transmissions are made each Sunday from 2 p.m. to 5 p.m. B.S.T. on approximately 1,050 metres. Occasionally there are transmissions on weekday evenings.

**"O.K." (Lytham)** *has a two-valve H.F. transformer coupled set to which he desires to add two more valves, and if possible to use a loud speaker.*

We suggest you use the circuit given to **"B.D." (Leeds)**, in which case you will have added one H.F. and one L.F. valve. **PCGG** should be very loud on this set. Signals should be sufficiently strong to operate the loud speaker satisfactorily.

**"FRAME" (Dundee)** *refers to page 37, April 8th issue, and asks what alterations to make to use with a frame aerial.*

A four-valve frame aerial diagram is given to **"W.D." (Huddersfield)**, (June 3rd issue), and this will probably be quite suitable for your purpose. It will give better results than the set to which you refer. The frame should be about 5′ square, wound with about 30 turns.

**"L.H." (Mansfield).**—As you are inexperienced in the use of valves, the simplest way to add one to your crystal set is as a L.F. magnifier. A diagram (Fig. 2) showing how to do this is given. The voltage required will be 30 to 50 volts of dry cells for the plate, with a 6-volt accumulator for the filament.

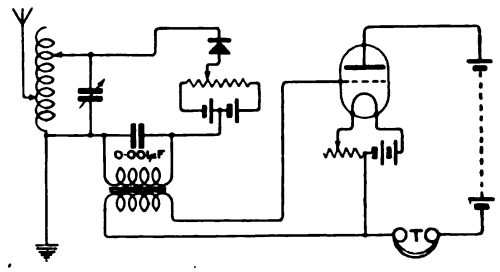


*Fig. 2.*

**"A.S." (Stockport)** *asks for particulars of telephone transformer for 120 ohm telephones.*

For this soft iron wire core, about ¼″ diameter and 2½″ long, together with 3 ozs. of No. 44 and 6 ozs. of No. 32 wire, will be required. Cover the core with a layer of tape, and wind on the fine wire in layers. Cover this winding with two or three layers of thin paper and wind on the thick wire in layers. The telephones should be connected to thick wire winding.

**"SIGNALS" (Bradford-on-Avon)** *asks* (1) *For condenser values of circuit, shown in Fig. 4, page 202, June 25th issue,* 1921. (2) *Refers to circuit, page 47, April 8th issue.* (3) *For criticism of two-valve set.* (4) *Which is the more efficient of two types of H.F. transformer.*

(1) The suitable values may be C.1 0·0005 mfd., C.2 0·0002 mfd., C.3 0·0002 mfd., C.4 0·0002 mfd. Telephone condenser 0·001 mfd., H.T. condenser 0·05 mfd. Grid leak, 2 megohms; potentiometer winding, 300 ohms. (2) This is given as a special circuit and, as the diagram agrees with the letter-press, we see no reason why it should not work satisfactorily. It is very probable that the insulation of the 0·004 mfd. condenser plays an important part. (3) This is quite an ordinary circuit and should be satisfactory if the proportions of A.T.I. and reaction are correct. (4) We do not care to say, as we have not tried these. In all probability separate transformers are slightly better.

**"AMATEUR" (Stoke-on-Trent)** *asks for criticism of aerial which does not give very good results.*

This appears to be a very good aerial, and unless the insulation is bad should be quite satisfactory. The receiver circuit, about which you give no information, is probably at fault. Write again, giving diagram of circuit and particulars of coils.

**"W.H.W." (Lancashire)** *has a two-valve set on which telephony is only weak. He asks for criticism of set and aerial.*

We think the aerial would be better if the lead-in was taken at the point B, giving a straight drop to the receiver. We do not think that a resistance capacity valve will work satisfactorily with two other valves, which are transformer coupled, and suggest that you add a third valve

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as note magnifier. We do not think you are doing badly to hear Croydon, as the existing H.F. transformer may not be most efficient at this wavelength.

**"R.M.S.K." (Manchester).**—If your inductance coil has only 8 tappings it will be advisable to connect the condenser in the lead from the aerial to the inductance for tuning between the studs. However, you might try connecting it across the inductance, as shown in Fig. 4, December 10th issue. To apply a battery to the silicon detector it will be necessary to have a potentiometer so that the potential on the crystal may be correctly adjusted. For leading-in wire use the same as for the aerial, and if possible have one long unbroken length for aerial and lead-in.

**"AERIAL" (Southgate)** *asks* (1) *How to eliminate buzzing from A.C. mains in a crystal set.* (2) *Which is the most sensitive crystal combination to use.* (3) *Criticism of circuit, and how many foils for blocking condenser.* (4) *Maximum wavelength, with a given size former.*

(1) The buzzing indicates a break in the crystal and telephone circuit. Trace connections and examine all joints. (2) Carborundum is the most stable crystal, but sometimes combinations such as zincite-bornite, or gelena steel point detectors are found to be more sensitive. (3) This is a normal elementary circuit. The condenser should have about 6 foils and its value would be about 0·001 mfd. (4) The maximum wavelength with No. 28 wire would be about 3,000 metres. This wire is too fine for an aerial circuit, which should not be wound with a wire finer than No. 24.

**"A.T. (Windsor)** *gives a circuit diagram, and wishes to know* (1) *The amount of wire required for the making of suitable basket coils for the set.* (2) *If the diagram is correct.* (3) *Asks for diagram of a three-valve circuit.*

(1) Without knowing the wavelengths, range and aerial dimensions, it is not possible to give definite details, but 20 basket coils of 2½" hole by 4" full diameter wound with No. 26 D.C.C. will probably tune your aerial circuit through the full range of wavelengths. Make the reaction circuit of 18 coils of the same dimensions as above, except for using No. 34 S.S.C. Take one coil of each circuit and arrange near together to provide for reaction. (2) Do not put a variable condenser in series with your H.T. battery. Join the H.T. minus to the filament circuit. You have omitted the lead from the L.T. minus to the earth end of the aerial circuit. Connect a small blocking condenser 0·001 mfds. across the telephone receivers. (3) See amplifier circuit, April 8th issue, page 37, for diagram and details of a good three-valve circuit.

**"D.P." (Sunderland)** *asks* (1) *For a method of adding "Ora" valve to his present circuit for use as an amplifier.* (2) *Connections for converting crystal to a single-valve set.* (3) *If a reaction coupler can be arranged without placing coils inside aerial circuit.* (4) *Particulars of reaction coil.*

(1) and (2) Connect intervalve transformer in place of telephones and connect up a secondary as shown in the right-hand portion of Fig. 8, page 100, April 22nd issue. It would be much better to adopt one of the usual single-valve receiver circuits, using your crystal, if you like, for the purpose of rectification. See page 140, April 29th issue, also circuit Fig. 5, page 140, April 22nd issue. (3) Make a small slab coil and connect in series in your aerial circuit, using a similar coil placed over it for the purpose of reaction. (4) Windings depend upon wavelengths required, but by tight coupling your two slab coils you can keep on adding wire when once you have found the approximate wavelength the circuit gives. It is regretted that definite information as to windings of tuning coils cannot be given, as they depend so much on the remainder of the tuning equipment.

**"ZENITH" (Liverpool)** *asks* (1) *Which of two aerials to adopt, and whether he might make his leads in spiral form owing to their shortness.* (2) *Which is the better valve to use for telephony, "Ora" or "R," and which is the best all-round valve.* (3) *The maximum receiving range for a single-valve set with Burndept coils.*

(1) Owing to the shortness of your aerial adopt the two-wire type. Do not wind spirally. (2) Both quite suitable for general telephony reception. Many types of valves are designed for specific purposes. (3) Range of reception depends as much upon the power of the transmitter as upon the type of receiver. British experimenters report reception on the high-power American stations on single-valve receiving outfits. The reception of **2MT** on a single valve by you in Liverpool is quite good.

**"EXPERIMENTER" (Liverpool)** *wishes to construct a portable aerial, 3′ × 2′ × 2″, and asks for windings.*

For wavelengths up to 2,500 metres wind with 100 turns of No. 30 D.C. and arrange for tappings at 10, 20, 35, 60 and 100 turns. For longer wavelengths you will have to use a two-pile winding.

**"F.T." (Southwell).**—Your circuit is quite correct. (2) Condenser "*a*," 0·0005 mfds.; "*b*," 0·0015 mfds.; "*c*," 0·001 mfds.; "*d*," 0·1 to 2 mfds. (3) Grid condenser and leak of correct values to suit your valve will improve results. (4) Quite suitable for the reception of **PCGG.**

**"OPTIMIST" (Forest Hill)** (1) *and* (2) *submits crystal circuit for criticism.* (3) *Asks if it is better to use insulated wire for lead-in.* (4) *Whether the earth lead should be insulated.*

(1) and (2) See circuit, Fig. 2, page 59, April 8th issue, and connect condenser, either in series, as is shown there, or in parallel, as you show, the former for short-wave reception and the latter for long wave. If your crystal is a perikon, omit the battery and potentiometer. The blocking condenser, presuming its value is suitable (0·002 mfds.) should be connected across your telephones. A closed circuit (inner coil) tuning condenser is recommended. (3) Aerial wire must not make contact with conducting or semi-conducting surfaces, and well insulate, either by using rubber-covered cable or by making use of an ebonite tube where the leads pass in to your instrument. (4) If your earth lead is long and can be kept well away from walls, etc., it should be insulated right to the point of earthing, otherwise take a heavy gauge bare conductor, such as No. 18 copper, to earth by the shortest route.

**"J.M.C." (Forress)** *gives a circuit of a two-valve receiver with X and Y terminals in first valve circuit for insertion of reaction coils and the other valve acting as a note magnifier, and asks* (1) *If the circuit can be improved by the addition of a high-*

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*frequency magnifier.* (2) *How to connect it.* (3) *Should he get* **PCGG.**

(1) and (2) No grid leak is shown in your circuit, but possibly the condenser itself is leaky, and we presume that you connect a reaction coil to the X and Y terminals. A small fixed condenser, 0·001 mfd., should be connected across the primary of the iron core intervalve transformer. One stage H.F. can be added externally, and we do not think you would have much difficulty in completely modifying your set and connecting as shown in Fig. 5, page 15, April 1st issue. The fixed condenser 0·001 on the right-hand side may be omitted, and your terminals X and Y used for those marked "reaction coils." (3) Provided you have a good aerial your set should readily receive **PCGG.**

**"VITTELLIUS" (Southampton).**—(1) Three valve set with single wire aerial 60′ high and 40′ long should be suitable for **FL** and **PCGG** telephony. If you can possibly arrange two wires separated at least 6′ apart you would considerably improve results. (2) No, it is not essential that you join up the whole circuit with 7-strand wire. The instrument connecting wires are so short that any resistance that may be added in the circuit will be inappreciable. The answer referred to meant that the entire aerial, including lead-in and earth lead, might be of heavy wire. (3) Basket coils are, as a rule, better than slab coils for long wave reception, but in assembling them they should be spaced at least ¼″ apart. In the hands of the experimenter high resistance telephones connected directly in the H.T. leads are usually satisfactory.

**"B.B." (Camberwell)** *submits diagram, and asks* (1) *If tuning coil* 9″ × 5″ *diameter wound with No.* 28 *would tune to* 2,000 *metres.* (2) *Capacity of variable condenser.* (3) *Resistance of crystal potentiometer.* (4) *Resistance of telephones.*

(1) Yes. (2) 0·005 mfd. Do not connect as shown, but in series in the aerial circuit, or in parallel across the inductance. See circuit, Fig. 3, page 60, April 8th issue. (3) 750 ohms, but do not use battery and potentiometer with a perikon detector. (4) 4,000 ohms.

**"A.L." (Stavenger)** *asks* (1) *How he can eliminate the signals of a near-by high-power station.* (2) *For particulars of a receiving set having one H.F., one rectifier, one L.F., tunable over a wide range and suitable for reception of telephony.* (3) *If the wire sizes used in England are Birmingham wire gauge.*

(1) We think you should have no difficulty in eliminating these signals. Use a loose-coupled aerial circuit, and you may experiment with a paralleled circuit tuned to the wavelength of the interfering signals. (2) See circuit, page 37, April 8th issue. (3) No. The English Imperial Legal Standard or S.W.G., which between sizes 20 and 30 is very nearly the same as the Birmingham standard.

**"E.B.G." (Aughton)** *has a multi-valve receiver amplifier set, and wishes us* (1) *To suggest the cause of howling.* (2) *Asks the name of the high-power transmitting station working at* 10.30 *p.m. on April* 20*th.*

(1) Your circuit does not appear to be quite correct, and the action of the crystal is rather obscure. In whatever position your switches may be it does not rectify the oscillations set up across the ends of the reaction coil. When using crystal rectification it is not possible to arrange a common H.T. battery for oscillator valve and rectifier. The three stages of L.F. after H.F. may give rise to howling. With so many switches the arrangement of the leads must be carefully considered, as either leaky or inductive coupling will cause howling. You might try reversing the connections of the transformer. If you wish to use more than five valves in an amplifier set we recommend that they should be all H.F. Make your transformers to the exact value of the wavelength you require to receive, and test each one either with a buzzer or in a single valve H.F. amplifier, and see that they all function correctly. See left-hand column, page 112, April 22nd issue. After many stages of H.F. amplification it is usually not possible to use more than two L.F. valves, and these may have to be run with rather excessive filament current to prevent howling. (2) In all probability Paris, as you suggest.

**"ABOUT TO START" (Hampstead)** *asks* (1) *For an elementary textbook on Wireless Telegraphy and Telephony.* (2) *Where he can get private tuition on the subject.* (3) *Whether a single-valve set is suitable for the reception of* **PCGG** *and all-round purposes.* (4) *What would such a set cost.*

(1) "The Amateur Valve Station," by Allan Douglas (price 1s. 6d.), Wireless Press, Ltd. (2) Try a small advertisement in this journal. (3) **PCGG** can be received in London on a single-valve set, but a more elaborate installation is recommended. (4) Having seen what you require from the textbook, look through our advertisement columns and, if necessary write to manufacturers for quotations.

**"F.H." (Kensington).**—The crystal circuit you show is quite correct and the dimensions satisfactory. Avoid using enamel wire for aerial inductances unless you require to make use of a sliding contact. D.C.C. is somewhat better, because the turns become more spaced and the capacity between them lessens. A carborundum crystal without potentiometer and battery is not very satisfactory. Try a perikon, consisting of a contact between zinc and copper pyrites. Telephone condenser capacity 0·002 mfds. Wavelength range about 2,000 or 2,500 metres depending upon the dimensions of your aerial. You should hear Poldhu and **FL**, and ship and coast stations. It is doubtful if you can receive **PCGG**, or even **2MT**, on crystal in London. For a method of adding a valve, see Fig. 1, page 61, April 8th issue. A book such as that by Allan Douglas, "The Amateur Valve Station," would no doubt help you.

**"J.H.A." (Bedford)** *asks* (1) *For a circuit of a coupled crystal tuner, range* 300 *to* 650 *metres.* (2) *Range of such a set.* (3) *If it is suitable for reception of telephony from Chelmsford.*

(1) For circuit, see page 59, April 8th issue. The condenser may be connected either in series, as shown in the figure, or in parallel across the ends of the aerial inductance. Omit the potentiometer shown and use a perikon detector. For 300 to 1,000 metres aerial coils 4″ × 4½″ diameter, wound with No. 28 D.C.C. Closed circuit 3″ × 3″ diameter, wound with No. 30 D.C.C., and for 600 to 6,500 metres aerial inductance 12″ long by 7″ diameter, wound with No. 28 D.C.C., and closed circuit 7″ × 5½″ diameter, wound with No. 30. Range depends upon power of transmitting station. You should get all the high-power spark stations

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of Europe, but it is doubtful if you will receive the ½ kW transmission from **2MT.**

"**D.V.D.**" **(Edinburgh)** *asks* (1) *For a simple aerial.* (2) *How many valves are required to receive* **PCGG** *with same.* (3) *For diagram of a suitable circuit.*

(1) A frame aerial about 4′ square, or an open aerial in the roof may be used. The open aerial should consist of several parallel wires joined in the middle or at one end, stretched out under the roof or in a long passage at the top of the house. The length should be as long as possible without the wires crossing. (2) Three or four will be required for good speech. (3) For the frame aerial a diagram was given to "**W.D.**" **(Huddersfield),** June 3rd issue. For indoor open aerial any ordinary tuning circuit and amplifier may be used. See instructional pages in issue of May 27th on the construction of aerials.

"**X.X.S.**" **(King's Lynn)** *asks* (1) *Who is* **BYE** *who is heard on about* 1,000 *metres.* (2) *Why* 600 *metre signals are improved when primary of loose coupler is shorted.* (3) *Number of valves for* **PCGG** *and* **2MT.**

(1) Ipswich Naval Station. (2) It is not clear from information given why this happens. It should not. (3) If a small variable condenser 0·0002 mfd. were connected across secondary, **2 MT** should just be heard without a valve. For **PCGG** two valves should be used.

"**V.D.W.**" **(Liverpool)** *asks* (1) *Best kind of amateur aerial wire.* (2) *What wire to use for lead-in and connecting to apparatus.*

(1) There are several kinds of stranded wire now on the market, or a single wire of No. 18 gauge copper or phosphor bronze may be used. (2) The aerial and lead-in should always be one unbroken wire if possible. If a joint is unavoidable, join on a piece of the aerial wire. For indoor connection use No. 18 wire or lighting flex.

"**V.J.**" **(Liverpool)** *asks* (1) *Resistance for a potentiometer.* (2) *If four-electrode valves may be obtained from the Marconi Co., and also price.*

(1) Any valve between 200 and 500 ohms will be suitable. (2) You should apply direct to that Company.

"**C.L.**" **(Huddersfield)** *asks* (1) *If single valve diagram is correct.* (2) *Why spark stations are only heard when set is oscillating.* (3) *If telephony should be heard with A.T.I. and A.T.C. in series.* (4) *Suggested improvements.*

(1) In the diagram the anode circuit is incomplete, a connection between telephones and negative L.T. being missed out. Otherwise O.K. (2) There is not sufficient control with the set. Use a 6-volt cell and variable resistance so that filament brilliancy may be controlled. Weaken the coupling between A.T.I. and reaction until set just stops oscillating. Pure note sparks should then be heard. Try different reaction coils. (3) Until the set is made suitable for spark stations as above, you will hear little telephony. A.T.I. and A.T.C. should be in series for ships and short-wave telephony. (4) If set works well for spark stations and you cannot hear telephony, the only thing to do is to add another valve.

"**E.W.C.**" **(New Southgate)** *refers to article on page* 560, *December* 10*th issue, and asks* (1) *If Fig.* 1 *may be changed to magnetic reaction set with slab coils for* 400,24,000 *metres.* (2) *If Fig.* 1 *above gives results equal to* 1 *H.F. and one reaction valve.* (3) *Best of three kinds of telephones to use for general work.* (4) *If Marconi four-electrode valve is on the market.*

(1) and (2) These circuits require testing experimentally before alterations can be recommended. Magnetic reaction may be adopted if the circuit is suitably modified. If you are pressed for time we recommend adopting a more standard circuit. A two-valve set will probably be efficient. (3) 120 ohm Brown telephones with telephone transformers. (4) Apply direct to that Marconi Co.

"**R.E.C.**" **(Guernsey)** *has a school receiving set and a three-valve L.F. amplifier which howls badly.*

To get rid of this howl which is caused by interaction between the L.F. transformers it is necessary to reverse one of the grid windings. Which one must be found by experiment. To stop school set oscillating use smaller reaction coil, and also vary the coupling between the coils.

"**W.T.**" **(Strathaven)** *asks* (1) *If single valve with crystal rectification circuit is correct.* (2) *Would* 2,000 *ohm telephones be suitable.* (3) *If telegraph wires a little distance away from the aerial will cause interference.*

(1) Connections are correct. The variable condenser might be 0·0003 to 0·0005 mfd. A 0·001 mfd. condenser across the telephones would be found an improvement. (2) They may be used with the circuit as given. (3) If the aerial is at right angles to the telegraph wires there should not be much interference.

"**H.H.V.C.**" **(Cardiff)** *is making reactance capacity amplifier and asks* (1) *For criticism of circuit.* (2) *If the intervalve tuning coils should be placed at right angles to one another.* (3) *Number of plates for* 0·0001 *mfd. variable condenser. Moving vanes* 3·25 *cms. radius, fixed vanes* 3 *millimetres apart.* (4) *If potentiometer to detector grid is advisable.*

(1) The diagram shown has the A.T.I. shorted by the aerial and earth lead. Presumably you intended to insert a condenser across this inductance instead of short-circuiting it. There should be a small condenser across telephone terminals. This may be about 0·001 mfd. (2) We do not think there is any particular advantage in doing this. (3) Four fixed and four moving plates will be required. (4) Potentiometer rectifier control is not always necessary. With soft valves it may be used with advantage. It might be an improvement to connect a potentiometer in the grid circuit of the three H.F. valves, and a separate one to control the rectifier.

"**G.D.**" **(Luton)** *asks if single valve circuit diagram is suitable for* 250,20,000 *metres with basket coils.* (2) *If possible to receive* **2MT** *telephony on set.*

(1) The circuit is quite suitable for the purpose desired. To cover this range you will require a number of basket coils and also coils of the honeycomb type. (2) Yes.

"**E.S.W.**" **(East Sheen)** *asks* (1) *If two-valve set, detector with reaction and one L.F magnifier is efficient.* (2) *Connections for same.* (3) *If separate filament resistances are necessary.* (4) *Number of plates required for* 0·001 *mfd. condenser. Fixed plates* 3·35″, *moving* 2½″ *diameter.*



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(1) Yes. (2) Suitable circuit is given on page 119, April 22nd issue. (3) No. (4) If the moving plates are 1/16" thick, and the spacing washers between fixed vanes ⅛" thick, 26 fixed and 25 moving plates will be required.

"SOUTHERN" (Maresfield) *asks* (1) *Capacity of condenser.* (2) *If possible to use capacity reaction with L.F. amplifiers.* (3) *Wavelengths of* POZ.

(1) Approximate 0·001 mfd. (2) Capacity reaction will probably make L.F. amplifier howl badly and is not to be recommended. (3) 3,900, 6,300, 9,400, 12,600 metres.

"VALVITUS" (Bournemouth) *asks for two-valve diagram with switching arrangement.* (2) *Particulars of winding for H.F. transformer.* (3) *Where to mkae tappings to H.F. transformer for different wavelengths.* (4) *Will signals be strong enough for 3' frame and loud speaker.*

(1) The circuit shown in Fig. 4, page 91, April 15th issue, with slight modifications will be suitable for your purpose. There should be a condenser and leak in the grid of the second valve and resistances in each filament in place of the common one. (2) and (3) Windings for an H.F. transformer to cover a range of 180/2,000 metres can only be determined experimentally. The transformers may either be in the form of a number of formers with two single layer windings to each, or of the slot type, the slots being alternately for primary and secondary windings. (4) On a 3' frame aerial about six valves will be required to satisfactorily operate a loud speaker.

"F.K." (Greenwich) *asks for three-valve diagram with switching arrangements.*

A suitable arrangement is shown in Fig. 5 page 62, April 8th issue.

"W.N.G." (Dovercourt) *gives single valve transmitter diagram and asks for suitable winding for A.T.I. and reaction.* (2) *Values of condensers A, B and C.* (3) and (4) *Value of resistance R, together with reason for using same.*

(1) Your diagram shows no connection from negative filament to earth. The A.T.I. may be 4" by 8" of No. 20 D.W.S. and the reaction coil 3" by 6" No. 24. (2) Condensers A—0·003 mfd., B—0·001 mfd. and C—0·01 mfd., all to be tested at twice the normal H.T. voltage. (3) and (4) The resistance R is necessary, and its value depends upon the type of valve used. The object of it is to maintain the grid at a most suitable value for oscillation by allowing the negative charge on the grid condenser to leak away. A suitable value would be about 10,000 ohms. Signalling is accomplished by opening and closing this circuit as shown in your diagram.

"A.B." (Durham) *asks for three-valve diagram with values of component parts.*

See reply to "D.F.T." (Lincoln) below.

"J.G.C." (Yarmouth) *asks for a diagram of circuit to utilise certain apparatus, also for sizes of inductances.*

As a commencement you will find the circuit given to "C.B." (Hyson Green), April 22nd, useful. The A.T.I. might be 6" by 10" of No. 24 D.W.S., and the reaction coil 5" by 8" of No. 28 D.W.S.

"D.F.T." (Lincoln) *asks* (1) *The wavelength of 4" by 8" A.T.I. (No. 24 wire) with 3½" by 7" (No. 28) reaction.* (2) *If above will tune to Hague wavelength with three-valve amplifier.* (3) *Finest wire which may be used for short wave A.T.I.* (4) *For three-valve diagram. One H.F., one rect. and one L.F. magnifier.*

(1) Inductance of A.T.I. 4,750 mhys. and reaction 7,000 mhys. This will tune a P.M.G. aerial to 2,000 metres, or 3,400 metres with a 0·0005 mfd. parallel condenser. (2) Yes. Wavelength is 1,050 metres approx. (3) For short wavelengths 300/1,000 metres. No. 22 or No. 24 wire should be used. (4) A suitable three-valve diagram is given in Fig. 3.

"J.R." (Bradford) *asks* (1) *If an "R" valve and "H" valve will work together in a two-valve set.* (2) *Why signals are weak when a two-valve set with* 1,000 *metre transformer is used.* (3) *How to obtain louder signals.*

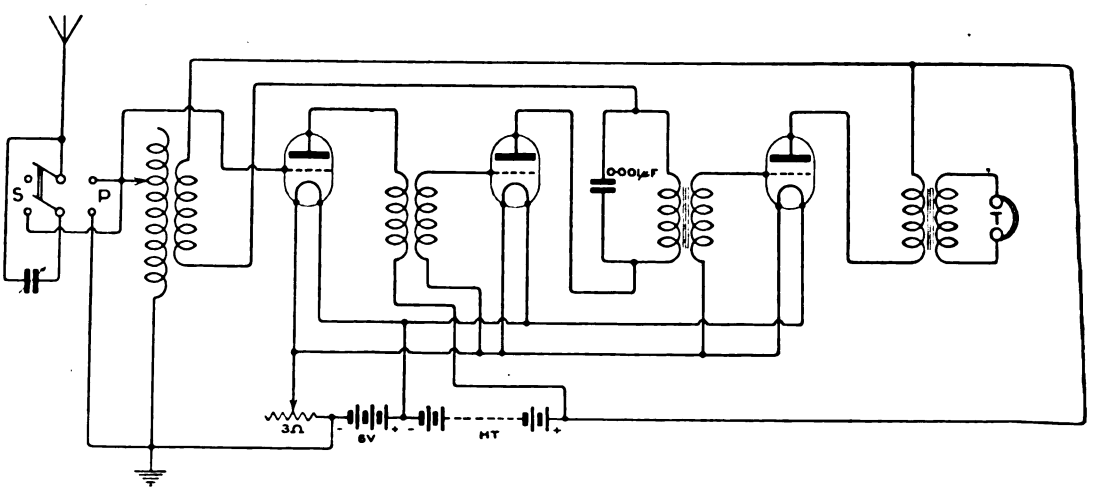


*Fig. 3.*

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(1) It is difficult to say without tests whether results will be satisfactory. The best way is to try it out. (2) A 1,000 metre transformer is usually only suitable for wavelengths from about 750 to 1,300 metres, and unless the signals to which you were listening were within that range they would be weak. You do not give any particulars of tuning circuit and reactance, which may not be correctly proportioned for the wavelength range. A 0·001 mfd. condenser across the telephones would be an advantage. (3) To obtain loud signals a two-valve L.F. amplifier should be used after the rectifying valve, but there may be a certian amount of distortion of speech.

**"D.G.C.T." (Merthyr Tydfil)** *refers to two valve diagram given on page 778, March 4th issue, and asks (1) Why he cannot obtain any results. (2) Are slab coils as good as basket, loose couplers and duolateral coils for telephony. (3) Why speech from* **FL** *and Croydon though strong appeared indistinct.*

(1) It is not at all easy for us to say why no results are received on circuits which behave well in more experienced hands. The circuit referred to would be improved if there was a 2 megohm grid leak between grid and filament of second valve; also if a variable condenser were used either in series or parallel with the A.T.I. With careful adjustment it should be possible to make set oscillate. (2) The term "slab coils" should include basket and duolateral. Slab coils, if of the correct proportions, may be adjusted to give as good result as loose couplers, but the adjustment is more difficult. (3) It was probable that your reaction coupling was too tight so that set was oscillating. Weaken it slightly by sliding coils apart.

**"C.E.T." (Tottenham)** *has made an "Amateur Mechanic" crystal set upon which he receives no signals.*

If you have connected up circuit as described, and have followed the instructions carefully, there should be no difficulty in making set work. Examine all joints and parts; also see that aerial is properly insulated and a good earth connection made. There is not much advantage in adding a valve until some results are obtained on crystal set.

**"C.L." (New Shildon)** *asks for information regarding a 2 H.F. valve with crystal detector set, using reactance capacity coupling.*

(1) The use of several coils for the inter-valve reactance will be unavoidable to cover a range of 100-25,000 metres. Full information was given in the issue of April 8th. (2) There should be little, if any, coupling between the inter-valve reactance and the secondary inductance of the reaction coil. (3) With resistance capacity coupling the H.T. voltage should be twice the normal anode voltage.

**"L.R.C.W." (Bordon)** *asks for criticism of two-valve diagram for use with frame aerial.*

Your diagram is incorrectly drawn. For correct arrangement see diagram given to **"C.B." (Hyson Green),** April 22nd. There is hardly sufficient amplification to use set with a frame. At least two more valves giving H.F. mag. would be required.

**"H.M." (Manchester)** *asks (1) For criticism of single valve diagram which is of coupled circuit type. (2) If two slide inductance could be utilised. (3) If a four-wire 15' indoor aerial would be sufficient. (4) If tuner, consisting of secondary sliding in and out of A.T.I. with reaction coil revolving at other end of A.T.I., will be best arrangement.*

(1) Circuit is O.K. (2) This may be used as loading coil in arrangement recommended in answer 4. (3) This would be suitable for the Manchester district broad-casting, but for stations farther afield more valves would be required. (4) To obtain best results with a coupled circuit set, the coupling between aerial and secondary circuits should be weak. Otherwise there is a considerable mistuning as coupling is varied. We suggest you make the 6" former the secondary, with the reaction revolving inside it. A small former about 4" diameter, 3" long, sliding in and out of the 6" former will give the required aerial coupling to secondary circuit with the above-mentioned two-slide inductance as aerial loading coil.

**"PONTY" (New Barnet)** *asks (1) If single valve diagram may be improved. (2) How to extend wave range to 100/30,000 metres. (3) Why a "heterodyned howl silenced by unison tuning" is received on certain wavelengths. (4) What would be quantitative effect, of putting the variable condenser in series with the A.T.I.*

(1) An improvement to set could probably be made if valves of grid condenser and leak were known. There should be approximately 0·0003 mfd. and 2 megohms respectively; otherwise O.K. This is as much as we can say without fuller particulars. (2) The whole of this range may be covered by the use of a suitable set of slab or duolateral coils, the smallest having about 30 turns and the largest 1,500 turns on a former about 2" diameter, and 1" wide. Twelve to 15 coils will be required to cover the range. (3) This phrase does not convey much information. It is probably a howl due to too tight a reaction coupling. (4) The resultant wavelength would depend upon the capacity of the aerial and the value of the inductances, and cannot be guessed at. The maximum reduction is to halve the wavelength without the series condenser.

**"Tyro" (Whitby Bay)** *has added a H.F. transformer coupled valve to single valve set without much improvement to signals, and asks (1) For criticism of circuit. (2) Information regarding H.F. transformers. (3) If 60 volts is sufficient H.T. for R and "Ora" valves. (4) If there is any advantage in using 6 volts for filament lighting.*

(1) The circuit is correct. You will probably find it an advantage to use a potentiometer in the first grid circuit instead of two dry cells direct (2) You do not give diameter of transformer former, but it is almost certain that this is not suitable for the job. For 1,000 metres the transformer should be wound on a 1½" diameter former with 4" of No. 40 wire to each winding. A small capacity condenser should be connected across the anode winding. Soaking in paraffin wax will not do any harm provided the wax does not remain soft. (3) Yes, O.K. for "R" valves, but is on the high side for "Ora." (4) A 6-volt accumulator with variable resistance should always be used as it gives control of filament brilliancy.

**"J.N." (Mile End)** *has a single valve set which does not come up to expectations. The circuit and aerial appear correct in all respects.*

The trouble is probably due to the slab coils. If wound with enamelled wire it is quite possible

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that the enamel has rubbed off in places, causing some of the turns to be short-circuited, and made the coil useless. Wind some similar coils yourself with different numbers of turns, and select a combination which gives best results. The howling is due to having too large a reaction coil, and may be overcome by using new coils or stripping turns off the one which gives the howl. When receiving spark stations, tightening the coupling should cause signal to gradually get stronger until the musical note is changed into a hiss. The set is then oscillating.

**"COUNTRYSIDE" (Barnsley)** *asks* (1) *For book on wireless apparatus for beginners.* (2) *What battery is required for valve on Mk. III* tuner.* (3) *What is the use of the buzzer on this set.*

(1) "The Amateur Valve Station," by Alan Douglas (Wireless Press, Ltd.). (2) The addition of a single valve to this tuner will greatly add to the efficiency for telephony stations. If this is a Mk. III short wave set, it is only suitable for the broadcasting waves of 350 to 425 metres, in addition to 600 metre ships. For the valve a 6-volt battery with variable filament resistance and a 30 to 50 volt H.T. battery are required. (3) The buzzer is provided for tuning up the receiver. A calibration chart of the secondary circuit is, or should be, provided, from which it is possible to set the secondary condenser to the wavelength it is desired to receive, then with the change-over switch in the "stand-bi" position, the buzzer sets the secondary oscillating at this wavelength, so that the aerial circuit may be also tuned to the same wavelength.

**"W.J.F." (Hornsey)** *asks regarding single-valve set* (1) *Wavelength range.* (2) *What long distance stations should be heard.* (3) *Suggested improvements.* (4) *Suggestions to receive telephony.*

(1) With A.T.I. and A.T.C. in parallel as shown in diagram, maximum wavelength 5,000 metres. With A.T.I. and A.T.C. in series this will be reduced to 3,000 metres, with a corresponding reduction in the minimum wavelength. (2) All European C.W. stations, working on wavelengths up to 5,000 metres. (3) Add series-parallel switch for aerial condenser; also reduce condenser across telephone transformer primary from 2 mfds. to 0·001 mfd. (4) On existing set it should be possible to hear Croydon and other aircraft stations on 900 metres, but for the new broad-casting it would be advantageous to make a smaller tuning circuit. For this an A.T.I. 3" × 4" of No. 22; for reaction 2½" × 4" of No. 26 should be suitable. The best value of reaction should be obtained by experiment, stripping off some of the turns, until set gradually works up to oscillating point.

**"D.G.B." (Putney)** *asks* (1) *If single valve circuit is correct.* (2) *If possible to use D.C. mains for H.T. for valve.* (3) *How many plates for 0·001 mfd. condenser.*

(1) This is a very elementary circuit, which will not be very effective. Disconnect the secondary circuit from the aerial circuit, and also do not short the idle sections of inductance. Connect reaction coil to slide in and out of secondary in the anode circuit as shown in many recent diagrams; also a 0·001 mfd. condenser across telephone transformer H.R. winding. If a grid condenser and leak is used a crystal detector will be unnecessary. (2) This may be done provided proper precautions are taken to prevent short-circuiting of mains or of earthing one or both of them. (3) If a variable condenser is desired sufficient information will be obtained from reply to **"E.S.W." (East Sheen).** For a 0·001 mfd. blocking condenser 2 foils 2" × ½" separated by 0·002" mica will be required.

**"G.H.R." (Ilkley)** *asks* (1) *How to add note magnifier to existing single valve set.* (2) *Type of inter-valve transformer to use.* (3) *Why set does not oscillate below* 1,000 *metres.* (4) *Size of basket coils for* 700 *metres.*

(1) A diagram showing how this can be done is given on page 213, Fig. 1, May 13th issue. (2) This should be a L.F. transformer, each winding consisting of 10,000 turns wound on a ¼" soft iron core, 2½" long. For this about 4 ozs. of No. 44 will be required. (3) No details of slabs are given so that we can hardly say if they are suitable. It is very probable that the A.T.I. and reaction slabs are not properly proportioned. For wavelengths below 1,000 metres the A.T.I. and A.T.C. should be in series. These sets require very careful adjustment to receive telephony. The position of the reaction coil being very critical and the tuning of the whole circuit very sharp. (4) With small tuning condenser in parallel with A.T.I., as shown in your diagram, the A.T.I. basket should be 1" inside diameter, wound with 50 turns of 26 S.S.C. A similar coil will do for reactance.

**"J.S." (Darwen)** *asks* (1) *Capacity of certain condenser.* (2) *Particulars of smoothing choke and condenser for use in adapting D.C. mains as anode battery.* (3) *Where to connect smoothing choke in circuit.*

(1) Approximately 0·001 mfd. (2) For a smoothing choke obtain if possible an old ignition coil secondary winding provided with a soft iron core. The smoothing condenser should be about 0·5 mfd. This may be made up with 100 sheets of tin foil 10 cms. × 5 cms. separated by mica sheets 0·003" thick. (3) The smoothing choke should be connected in the positive H.T. lead. In adapting D.C. mains for use as H.T. great care should be taken as regards earthing the filament of the valve. If there is already an earth on the positive main, earthing the filament will cause a short circuit of the main. This must be avoided.

**"F.T.M." (Battersea)** *asks* (1) *If possible to receive* **PCGG** *on two-valve set shown on page* 202, *June 25th,* 1920. (2) *What value of grid leak to use.* (3) *Capacity of certain size of condenser.*

(1) Yes, if the inter-valve transformer is correct for 1,000 metres. (2) As a potentiometer is used the grid leak value will not be very important: probably 1 to 2 meghoms will be suitable. (3) 0·0005 mfd.

## SHARE MARKET REPORT.

Prices as we go to press on June 2nd, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 14 | 0 |
| ,, Preference .. .. | 2 | 9 | 0 |
| ,, Inter. Marine .. .. | 1 | 14 | 6 |
| ,, Canadian .. .. | | 12 | 0 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 3 | 9 |
| Preference .. .. .. | | 15 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. NO. 12. JUNE 17TH, 1922. WEEKLY

## Methods of Deriving Valve Current from Public Supply Mains

By F. H. HAYNES.

THIS subject may be divided into four main headings :—

(1) The production of H.T. from D.C. mains.
(2) L.T. from D.C. mains.
(3) H.T. from A.C. mains and
(4) L.T. from A.C. mains.

(1) H.T. FROM DIRECT CURRENT MAINS.—This is without doubt the easiest and offers several alternative methods, and the two given below are generally favoured. All D.C. supply will have one main earthed and in practically every case it will be the negative. Leads must be run from the mains to a convenient point for connecting to the apparatus and should terminate on a double pole switch, followed by 1 amp. fuses (Fig. 1).

Two batten-type lamp holders are arranged as shown for joining two lamps in series and connecting them across the supply voltage, to which also is paralleled a condenser of good insulation, having a capacity of two microfarads. This condenser has the property of shunting a good deal of ripple

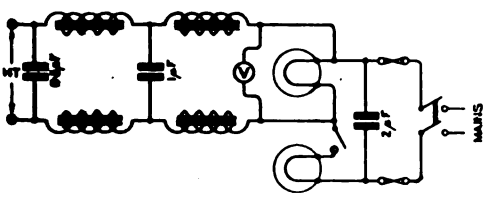


*Fig.* 1.

off the mains before the H.T. potential is bridged off, and consequently if the H.T. voltage required is half that of the mains this condenser is twice as effective across the whole voltage, as it would be if it were only joined across the leads providing the H.T. potential.

The choke coils are shown in the circuit as being separate coils in opposite leads. This is preferable to the method of winding opposite coils on a common core, as it reduces the liability to breakdown. Intervalve transformers may be used as chokes but it would probably be more economical to make special coils to the following details. The core which has a diameter of $\frac{3}{4}$" is shown in Fig. 2, arranged with end cheeks which fit tightly and are $1\frac{1}{4}$" × $1\frac{1}{4}$" × 5/16" ebonite. The outer sharp edges of the holes carrying the core are countersunk

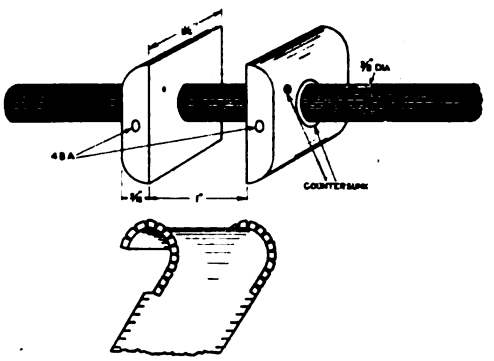


*Fig.* 2.

in order that when the core has been wound the core wires which are of No. 22 or finer, soft iron, may be divided and a half bent round on either side to completely close the magnetic circuit. Opposite edges are also rounded for the same purpose. Holes are made in one edge of each end piece and tapped 4 BA to provide for fixing the coil when finished to a base. Other holes are also made for passing out the leads and these, too, should be slightly countersunk to remove sharp edges that would be likely to damage the wires. Before winding, a piece of empire cloth, moistened on its inner face with oil to prevent rusting, must be wrapped round the core, leaving no parts exposed. The cheeks are spaced 1" apart and the piece of empire cloth should have a total width of about $1\frac{1}{16}$" and small cuts made in its edges so that there may be a turning up against the cheeks to obviate any possibility of the wire slipping down into contact with the core. In securing this piece

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of insulating material in position, the reader is cautioned against the use of certain well-known adhesives as the preservatives and other materials they contain frequently have low insulating properties. A little tacky shellac varnish and cotton wrapping is the best way of holding down the edges of the empire cloth. The most convenient way of winding the bobbin is, of course, to wrap one end of the core tightly with bare copper wire and hold it in the chuck of a light lathe, which can be run at high speed, but if this is not available an arrangement can probably be improvised by the experimenter for revolving it by means of a small hand brace held in the jaws of a vice. Alternatively clearance holes may be made in wooden uprights to act as bearings and a stiff piece of wire bound round one end of the core will serve as a handle.

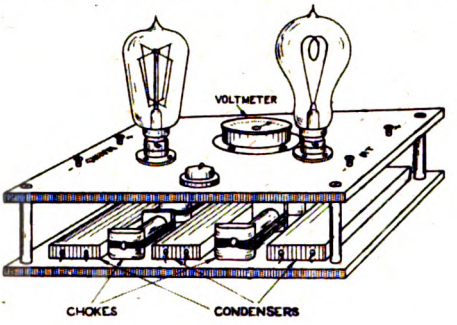


*Fig.* 3.

This will be rather a slow process for winding but provides a means which, with a little patience, is entirely practicable. The wire used should be between 38 and 42 gauge with a single silk covering and is wound on to a diameter of about $\frac{7}{8}$" or a little more than half an ounce of wire. The ends are brought out through the cheeks by flexible leads composed of several strands of fine insulated wire. On the completion of the winding a piece of stiff fibre is wound over the wire, tightly fitting between the cheeks, and serves as a covering for the windings and also to prevent the cheeks from closing in when the core wires are bent round. This piece of fibre will need to be tied round with thread to keep it from springing open. The core wires will also need to be tied round after being bent, to keep them in position. This completes the construction of a choke coil and it may be noted that this design is equally suitable for the construction of intervalve and telephone transformers excepting that primary and secondary are required and an additional piece of empire cloth insulation between the windings. Four such coils will be required and connected together as shown in the diagram. Two more bridging condensers of value 1 mfd. and $\frac{1}{2}$ mfd. are connected across the chokes at the points shown.

This arrangement provides a very effective way of eliminating the ripple usually present on supply mains, and on most circuits can be used as a source of H.T. for operating multi-valve amplifiers without undue humming. Adjustment of H.T. voltage to any value from a few volts up to the maximum across the mains may be obtained by using lamps of various voltages, patterns, and candle powers. A convenient arrangement is to have a number of miscellaneous lamps, suitably marked for identification, and to prepare a chart, showing the voltages that various combinations of lamps will give. If it it is desired to use a voltmeter for showing the potential it must be connected across as shown in the diagram, for if it is connected beyond the chokes it is apt to give a low reading depending upon its efficiency, and moreover, the current which actuates it will have to be passed by the chokes. Connected on the H.T. output side it is also liable to re establish the ripple if many valves are operated. Fig. 3 is a sketch of a complete outfit made up on the lines described.

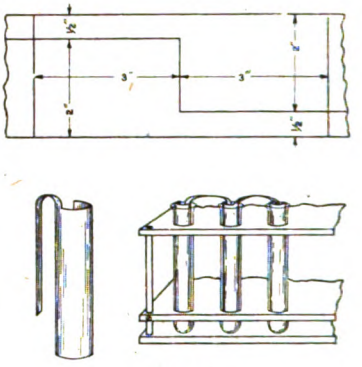


*Fig.* 4.

Another method is to build an accumulator battery of many cells and charge it from the mains. This system gives very little trouble and entirely eliminates ripple particularly if the cells are not on charge at the time of being used. There is the objection, of course, that batteries, owing to the use of sulphuric acid, cannot be incorporated in a set as a part of it, ready for operation from the electric lighting circuit. A method of constructing the battery is shown in Fig. 4. The plates are cut from sheet lead about $\frac{1}{16}$" thick, or of just sufficient thickness to retain their shape. Fig. 4 also shows how to cut the plates from the sheet without waste. In order to increase the effective surface, a number of parallel cuts are made as close as possible together on both sides of the narrow end, and one side of the wider end. The wider end is then bent round a piece of cylindrical wood with the grooved face inwards, to give it a circular shape and sufficiently small to give it a good fit in the glass boiling tubes. To prevent the positive, which will be the inner strip, from making contact with the cylindrical negative, it must be wrapped with an insulating material that will permit of the free flow of the acid. The best way of doing this is to fit inside the negative a piece of corrugated celluloid of the kind specially made for this purpose. The plates require no special treatment with oxides of lead, as is usual with larger cells, before bringing into use. The rack shown in the figure for holding the tubes must be liberally treated with paraffin wax to prevent it being acted upon by the acid and to maintain insulation between adjoining cells.

The charging rate for such an accumulator battery is very low. The current passed by a

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metal filament lamp connected in series with the battery and across the mains is suitable for charging (Fig. 5). If the charging rate is 0·25 amperes and the battery is kept on charge for fifteen minutes, it will acquire a charge of almost $\frac{1}{16}$th of an ampere hour, which will suffice to furnish the H.T. for a multivalve amplifier for several hours.

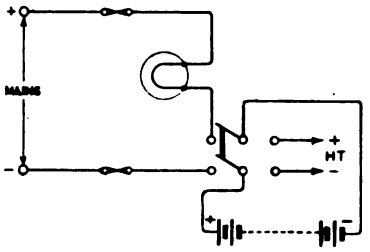


*Fig. 5.*

(2) L.T. FROM DIRECT CURRENT MAINS.—Where a D.C. supply is available it is usually preferable to charge accumulators and to use them for the purpose of providing the L.T., but where the use of accumulators is not desired, valve filament current may be provided by a potentiometer arrangement.

It is always possible, of course, to connect the valve filament to the mains through a suitable resistance, but such an arrangement is usually rather dangerous as it is difficult to critically adjust the current from a high voltage supply and also the control of the grid potential presents difficulties.

Fig. 6 shows a circuit arranged on the potentiometer principle and in order that a series filament resistance may also be made use of, it is necessary to provide a current flow across the potentiometer resistance of slightly more than that required by the valves. To provide this resistance one must employ wire capable of carrying the requisite current without excessive temperature rise and for the more general gauges of "Eureka" wire may be taken as shown in the accompanying table, which also gives the resistance per yard and the approximate number of yards required on the more usual supply voltages.

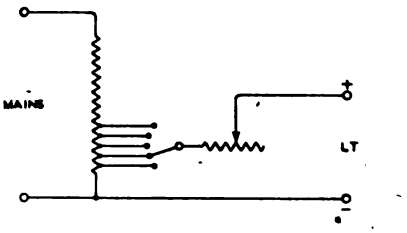


*Fig. 6.*

| Number of Valves. | Gauge S.W.G. | Current Carrying Capacity. | Resistance per yard. | Length required for various voltage. | | | |
|---|---|---|---|---|---|---|---|
| | | | | 100 v. | 200 v. | 220 v. | 240 v. |
| | | amperes. | ohms. | yds. | yds. | yds. | yds. |
| 1 | 22 | 1·09 | 1·09 | 100 | 200 | 220 | 240 |
| 2 | 20 | 1·6 | ·661 | 100 | 200 | 220 | 240 |
| 3 | 18 | 2·5 | ·372 | 110 | 220 | 240 | 260 |
| 4 | 16 | 3·75 | ·210 | 120 | 240 | 265 | 290 |

It will be seen that the amount of wire needed to pass the required current is of unwieldly length and arrangements must be made for winding it into a convenient form, at the same time bearing in mind that insulation must be maintained and that the wire is likely to become fairly hot. One method is to take a board about three feet long and screw to its opposite ends a row of small bobbin porcelain insulators and zigzagging a resistance wire tightly between them. In lieu of the board the under side of the operating table may be used, but in stowing the wire out of sight there is a danger of overlooking excessive temperature rises. It must be pointed out that this arrangement of deriving L.T. directly from D.C. mains must not be regarded as economical, for supposing a three-valve set is used on a 220 volt supply, over ½ a kilowatt will be used.

If L.T. and H.T. is to be obtained simultaneously very little consideration is required to devise a suitable circuit.

(*To be concluded.*)

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# Some Effects of Capacity on Mutual Induction

## WITH SPECIAL REFERENCE TO THEIR APPLICATION TO THE ELIMINATION OF JAMMING.*

By J. H. REEVES, M.B.E.

BEFORE I start reading this paper I wish to express my regret that certain demonstrations I had arranged have, for some reason, fallen through. I have to ask your indulgence to take it that what I intended to do, actually takes place.

It will be well if I explain exactly what is meant by the words, "Mutual Induction," in the title. In my student days high-frequency oscillations were not a feature of every-day life, and for the low frequencies of 50 to 100 periods of ordinary electrical power distribution, the coefficient of mutual induction was, in effect, a measure of the power of alternating currents in one coil to produce an alternating E.M.F. in one adjacent to it. Till a little while ago I regarded the words "mutual induction" to have the same meaning with respect to coils carrying radio-frequency oscillations, but I now understand that mutual induction is used only in connection with true magnetic induction, and that the power mentioned is described by the words "total coupling." This total coupling is then the resultant of true magnetic mutual induction and the effect due to electrostatic coupling arising from the fact that all coils must have a certain amount of self and mutual capacity.

Now magnetic induction is a function only of the dimensions and relative position of the coils employed. By making certain assumptions, the coefficient of mutual magnetic induction can be calculated mathematically. Elaborate expressions are given in Eccles's "Handbook of Wireless," pp. 70–74, and the mathematical development by means of Bessel's Functions formed the subject-matter of Professor Howe's presidential address to the Radio Section of the Institute of Electrical Engineers. I have searched in vain for corresponding expressions for self and mutual electrostatic induction, and I hope someone will be able to throw some light on this matter, because I find that in quite ordinary circumstances of reception with loosely-coupled circuits the effect of electrostatic coupling exceeds that of magnetic.

As a recent beginner in wireless I started in the days of multi-valve amplifiers. In company with most beginners my initial circuit was a one-valve single coil circuit with reaction; naturally before long I found from practical acquaintance the meaning of the word "jamming," and later as amateur telephony at 1,000 metres grew in volume I learnt the meaning of distortion, and for some while now all my efforts have been directed towards obtaining as near as possible perfect enunciation of music and the human voice with elimination of jamming. The first great step towards these objects consisted of substituting coupled circuits for the single coil one. Countless others have advocated this as being well worth the extra expense and the extra trouble in tuning. If only every amateur would do the same we should be freer of the condenser swinging fiends, who too often make Sunday afternoon hideous by their efforts to get the Dutchman's carrier wave on half a valve.

One day, working with Burndept coils, on the usual type triple mount, I noticed that as the coupling was gradually loosened from its tightest position a certain signal died away to zero, or nearly so, and then came on again. This position of zero signal strength I have called the "Silent Point," and in conversation with others I gather that quite a number have noted this phenomenon. I further noted that in receiving signals of different wavelengths the longer the wavelength the looser had to be the mechanical or apparent coupling before the silent point was reached. One day, listening-in to Croydon very loosely coupled, I was badly jammed by **GFA**, and it occurred to me to try the effect of tuning-in Croydon at that coupling which formed **GFA's** silent point. The experiment succeeded. I got Croydon without a sound of **GFA**, but an alteration of the coupling either way made the latter audible. This observation was the starting-point of my investigations and ultimately of this paper. I tried in like manner to get rid of **BYK, BYM** and other Admiralty stations, but this failed, partly because there was no true silent point for any of them, but only a minimum point, and this was so close to Croydon's own silent point that even his signals were very feeble and, in consequence, they were still masked by those of **BYK**, etc.

In this common form of mount there is only one degree of freedom of movement, that is to say, for a given distance between the coils the angle between their planes is fixed, so I made another mount by which I could vary independently the distance and the angle. The result, however, was the same. I could always eliminate **GFA**, but could not get rid of **BYK**, etc., without making the other signals so feeble as to be useless. So I put the matter on one side and proceeded to make a large reception unit, the two bottom panels of which I have rough mounted to show you. These are made almost exclusively from parts of the Mark III short wave tuner.

The reception coils are wound with No. 26 D.C.C. wire on the formers, turned smooth. The middle one, stationary, is the secondary, one movable, is the A.T.I., and the other movable is a reaction coil. Above these is the detector, which is a seven-valve Marconi type 55 D, and beyond these coupling coils are loading coils for the higher wavelengths. For 1,000 metres about three-quarters of both the A.T.I. and secondary are needed.

One evening I was using this set to receive

* Paper read before the Wireless Society of London on the 24th May, 1922.

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Mr. Maurice Child (1,000 metres, 10 watts), when he was badly jammed by **BYM**. Slowly loosening the coupling till the movable coil was nearly square with the stationary one, I found I could entirely eliminate **BYM** and yet get Mr. Child quite clearly and of more than readable intensity. The adjustment was extremely critical. By a movement of the handle either way, hardly perceptible to the eye, **BYM** came in and entirely obliterated the telephony. This experiment was several times repeated in the hearing of a few members of the Kensington Wireless Society, and in exactly a similar way I could get rid of **GFA**, but never both **GFA** and **BYM** simultaneously.

I had intended to demonstrate to you how critical is the adjustment required. This experience encouraged me to undertake a systematic investigation of the principles underlying this phenomenon. To describe in detail all the experiments would take far too long. In brief, I found that whatever was the original distance apart of the coils, I could almost invariably obtain a silent point with all wavelengths I used, mainly 600, 900, 1,000 and 1,450. Sometimes the adjustment had to be extremely critical, and at others not so. Finally I put together this little reception circuit, which I show you.

You will notice I have added a slow movement for coupling, together with a vernier to measure the approximate amount of movement from one silent point to another. For 600 metres I got a well-defined point with $\frac{3}{4}$" overlap, for 900 metres the overlap was $\frac{1}{2}$", and for 1,450 metres it was about 0·2". Hitherto no particular note had been taken as to the connections of aerial and earth grid and potentiometer to the respective coils, so while at the silent point for 600 metres I reversed the aerial and earth leads to the A.T.I. Strong signals at once came through, which could only be silenced by further loosening the coupling till the coils were clear of one another, as on pushing this loosening further I could get no readable signals. I reverted to the original connection, and noted that the various leads were joined up as in Fig. 1. At this

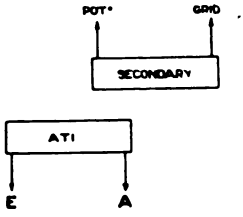


*Fig.* 1.

stage I thought I could enunciate the laws of total coupling as follows, viz. :—

1. The total coupling is compounded of two,
   (*a*) true magnetic, independent of the frequency,
   (*b*) electrostatic, which increases with the frequency.
2. The electrostatic is opposed to the magnetic and is of the nature of a back E.M.F. similar to that of self-induction. At coupling "tight" the magnetic exceeds in strength the static. As the coupling is loosened the magnetic falls off more rapidly than the static, till the silent point is reached, when they are equal. Beyond this point the electrostatic is in excess.
3. If the coupling is inside the silent point, the signals come through by reason of excess of magnetic, if outside the silent point, then by excess of electrostatic.

Subsequent experiment added a fourth law, which modifies 2 ; but, in the main, I think these laws are true.

The immediate result was the question, "What will happen if the capacity coupling is greatly increased ?" I set about finding a means to make such an increase.

In Stanley, Vol. I, p. 359, a coupling is shown where the aerial end of the A.T.I. is connected to the grid end of the secondary through a small variable condenser. Stanley calls this "electrostatic" coupling. A similar coupling is shown in Eccles, p. 89, Fig. 18. He calls it "electric" coupling. I think, for reasons to be given, the latter expression is the more correct, and I looked for a true static connection which did not involve metallic connection with the active ends of the two coils. Eventually I evolved what I now call "static couplers," and will return to the electric coupling later.

The first pair of static couplers consisted each of a strip of aluminium, $\frac{1}{4}$" wide, embracing about half the circumference of each coil. One strip was placed over the active end of each coil and the two were joined by a wire. Small but definite results were obtained, and I made a larger pair, $\frac{1}{2}$" wide and embracing nearly the whole circumference. Later still, fearing damping effects from eddy current, I constructed laminated couplers. On a former of the right size diameter I placed one turn of $\frac{1}{4}$" insulating tape ; on this I wound about 20 turns of No. 26 enamel-covered wire. Baring the insulation along a line parallel to the axis, I soldered a bridge-piece across the turns, and then cut through the whole helix at the point opposite to the bridge-piece. I thus got a plate with 20 laminations, insulated in the direction in which eddy currents might arise.

I will now demonstrate the effect of these couplers. You notice that while over the inactive ends no result is noticeable, but as I move them towards the active ends the coupling has to be continuously tightened to get the silent point. With this pair of couplers, with these identical coils, the A.T.I. being detached from its mount, I and many others have heard 600 metre signals from the Mediterranean, with the coils 10' apart. Indeed, after a foot or so between the coils, the signals remain of constant strength, however much this distance is increased.

The immediate deduction is fairly obvious. In the original form the elimination of jamming was due to the difference of two coupling effects, both of which fall off as the coupling is loosened, while the effect of the static couplers is independent of distance. Hence, to get maximum sensitiveness a good plan seemed to be to reduce the capacity of each coil to a minimum and to rely on the static couplers for the elimination. As it was desirable to have close uniformity in winding coils of the same inductance with varying self-capacity, I looked round, and found at Tingey's a number of the cases covering the condensers taken out of the

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Mark III tuner. On these, in a screw-cutting lathe I have wound on these as formers, coils of the same pitch, and hence of approximately the same number of turns of Nos. 32, 36, 40 and 47 gauge wire. Some of my observations on these fine wire coils have been interesting and instructive, and I hope to have time to refer to them later, but I now come to an accidental discovery, due to my want of experience in using a screw-cutting lathe.

I have here two coils, mounted side by side, to all external casual investigation the same. They are both of 36 gauge, 84½ turns, spaced 22 to 1"; but one is a right-handed, the other a left-handed helix. It was my intention to demonstrate their different action in connection with this third coil, which is right-handed. It would have been seen that with the left-handed coil a decided silent point was reached in the end-on position, but not in the side-by-side position, but with the right-handed coil these results are reversed.

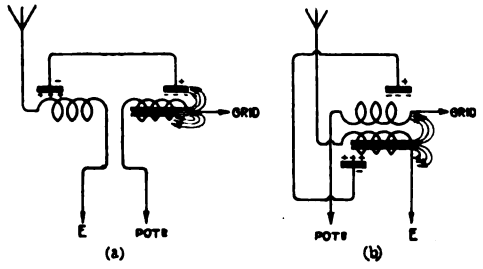


*Fig.* 2.

An explanation of this may be found by a consideration of these two figures, Figs. 2 (*a*) and (*b*). The first indicates two right-handed coils in the end-on position with the static couplers in place and the second, the coils in the side-by-side position. If then, the incoming wave is at the maximum positive potential, the magnetic field runs as indicated by the arrows.

The effect of the field is in the first case to make the grid end of the secondary negative, but as in the second the direction of the field in the secondary is reversed, the grid end is positive. The effect of the static couplers is always to make the grid end negative. Hence, in case 1, both effects are of the same sign, but in case 2 of opposite sign and a silent point is to be expected.

Further, replacing the right-handed A.T.I. by a left-handed, or reversing the aerial and earth connections to it, or changing the end-on to the side-by-side position, each in turn produces a change in sign of the grid potential due to the magnetic portion of the coupling. Hence we get the following possibilities to obtain a silent point, with consequent elimination of jamming by waves of one length: (*a*) Both coils right (or left) handed as in Fig. 3 and (*b*) One coil right, the other left-handed as in Fig. 4.

These figures give a variety of selection, but for reasons of convenience I prefer the end-on position, and the preferable arrangements seem to me to be:—

1. For thick wire coils, use two right-handed coils. Place the couplers in position as in A(i), but put a switch or plug in the connecting wire; also place a reversing switch in the aerial and earth connections to the A.T.I.

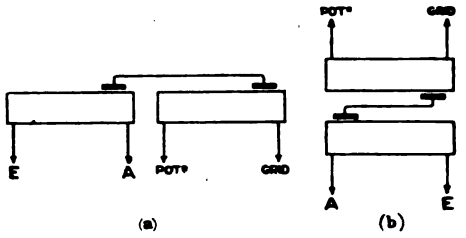


*Fig.* 3.

Normally make these connections as in A(ii) and leave open the plug. To avoid jamming, which even the loosest coupling cannot eliminate, reverse the aerial and earth switch and close the coupler plug.

*N.B.—If the coils are tapped, the permanent fixture must be at those ends immediately under the couplers.*

2. For thin wire coils use B (i) and work normally with the coils well apart. To stop jamming tighten the coupling. This is my usual method in connection with these coils of 40 gauge.

This pair, right and left-handed, with the third, serves also another useful purpose in that we can get some measure of the coupling power both of the static capacity of the coils themselves and of the couplers. Given a source of constant strength, the silent point for the right and left-handed pair can be found. The third coil is now placed opposite the right-handed one and the signals are received on this pair. As by the former trial the magnetic and static couplings are equal, the effect of each is half the signal strength obtained in the latter trial. Time will not allow me to make these measurements this evening, but the difference between the results of this pair of No. 36 and this pair of No. 26 is decidedly noticeable.

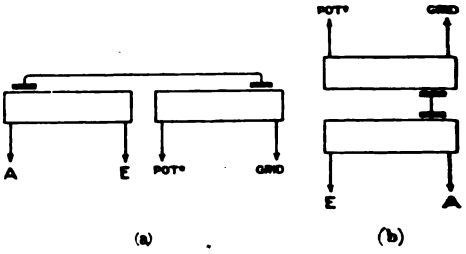


*Fig.* 4.

I will say a little about these fine wire coils which I have found (for short wavelengths, i.e., from 1,000 downwards, on my particular reception set) very effective. There is no need to emphasise the need to eliminate self-capacity as far as possible while keeping the coils of reasonable size. I can

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say nothing of the relative values of the different coils on the market for long wavelengths.

Suppose then we start with a single-layer cylindrical coil, wound on a former of this size, which is a little over 3" diameter. It is to be tapped, and the number of turns to make it reach 1,000 metres is about 75 to 80, and occupies with No. 26 D.C.C. about 2½" of the former. What happens if the 26 wire is replaced by say 36, wound to the same pitch, or as I have standardised it 24 to 1", 72 turns, occupying 3" length. The inductance is much the same, the self-capacity is diminished and the resistance increased. The mathematicians have given us a damping coefficient, due to the ohmic resistance, but I do not know of a similar one for self-capacity. I believe there is one for distributed capacity along a straight line, such as a submarine cable. In the absence of a coefficient of capacity damping effect nothing but experiment can see how far the increase of efficiency due to decreased capacity compensates for the loss due to ohmic resistance.

The question is also complicated by consideration of clearness of articulation. One man is contented provided he can understand what the person transmitting is saying, and aims at getting his results with a minimum of valves; another man does not mind an extra valve or two, provided that by so doing he gets nearer his ideal of complete absence of distortion. I will mainly speak of, firstly efficiency, and secondly clearness of articulation.

As regards efficiency, this set of tapped No. 40 gauge coils have been tried on a number of circuits, the H.F. sides of which have included resistance-coupled, reactance-capacity-coupled and various types of transformer-coupled units. On one they were classed as highly inefficient, but on most, provided the reactance coil was used, the signals were as good, or very nearly so, in point of loudness as with various types of lattice, cylindrical and basket coils.

As regards clearness of speech. At audio frequency the damping effect of the small capacity of any of these types ought to be small, but it may be serious on radio frequencies. Speech, as transmitted by wireless, consists in general of the variations in amplitude of the carrier C.W. of constant frequency. Hence, if the damping coefficient is not a function, *inter alia*, of the amplitude, both high and low musical notes should be damped out in the same ratio, that is to say, in wireless transmission of telephony, capacity damping ought not to affect the clearness. A recent article in *The Wireless World and Radio Review* shows that this is not so if the carrier wave is long, but as we are dealing with waves of 400 metres the statement is closely accurate. This deduction does not apply to iron-cored transformers. My experience does not however bear out this deduction. Everyone who has listened-in with these coils on my own set agrees that the absence of distortion is distinctly marked, and this has been found so by trying them on certain others.

On some the improvement is not much, but it is impossible to dogmatise, as so many other conditions enter into consideration. It is, however, clear that here is a matter on which every amateur can experiment for himself, and, with a view of helping those who would care to experiment, I have brought here the rough instrument on which all my latter coils have been wound, and I will be pleased to show it to anyone after the meeting as also the different types of tapping details I have tried.

Besides these main points there are others, which I will briefly enumerate.

The tuning is extremely sharp. Without using the silent point method of elimination, I have tuned out **GNI** as against **OST**, and *vice versa*.

The high damping resistance factor alone blots out such long-wave jamming stations as **FL**. The difference in this respect between the 26 and the 40 gauge coils is very marked.

I do not know if during this year atmospherics have existed. With the exception of a very few evenings, when heavy thunderstorms were close, I have not heard an atmospheric for months.

They are more difficult to get to oscillate, but not inordinately so. You see how small a reaction is needed down to 300 metres. Lower I have not yet tried. This property is a valuable asset in circuits prone to oscillation, as is mine.

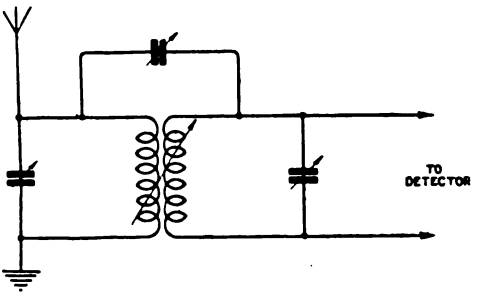


*Fig.* 5.

I will now return to the electrostatic coupling of Stanley, Vol. I, p. 359, and Vol. II, p. 92. Fig. 5 needs no explanation. The variable condenser must be very small indeed, *i.e.*, a billi, in dealing with wavelengths of 1,000 and under. I have not tried it on higher. Its effect is precisely the same as that of my static couplers, and gives a third alternative method of working. In this method the mechanical coupling may remain fixed, and the jamming station eliminated by varying the small coupling condenser. However, in Stanley, Vol. II, p. 93, it is pointed out that the variation of this condenser alters the wavelengths of both coils. To a certain extent this is also the case, if the metal connection between my couplers is made or broken, as the case may be, but so far as my experiments have gone the alteration in the former method is considerably larger than the latter, and therefore in practice it requires more care and trouble in adjustment of the tuning condensers. Again, in using this form of coupling I have found **FL** much more liable to break through, nor is this surprising, because the oscillations forced on the aerial are but little affected by the tuning of the A.T.I., and we have, more or less, through this coupling, a single circuit working, through the secondary coil, and therefore just as liable to jamming as is the case of the plain single coil reaction circuit. In this matter my experiments have been few, because as soon as I got **FL** breaking



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through, which never happens with the other form of static coupling, I gave it up, and it is possible that under different circumstances these defects may vanish. It is a very easy matter for anyone to try for himself by joining the aerial terminal to the grid through a variable billi condenser, taking care that the magnetic coupling between the reception coils is in the right sense, as indicated above.

As a last example of the use of either of these methods of electrostatic coupling, I will refer to a point raised in this room some months ago when the lecturer spoke of intervalve transformers which do not transform, and of the reactance capacity coupling. Contrast Figures 6 *a*, *b* and *c*. Are not (*a*) and (*b*) both modifications of (*c*) ?

In (*a*) the two coils of (*c*) are coupled as tightly as possible with or without tuning.

In (*b*) the second coil and condenser (*c*) are cut out and replaced by the simple plate of a second condenser, the two condensers in series thus formed being replaced by their equivalent single condenser, or *vice versa*. Diagram (*c*) is an extension of (*b*), in that the condenser of (*b*) is made tunable. Here both coils being of identical inductance, and placed well apart, the two condensers can be equal and manipulated similarly by one handle, so that with no more trouble in tuning in than is the case with (*b*) we get a doubly tuned anode circuit, with its consequently increased selectivity. We might even go further by making the coils of (*c*) right and left-handed, though otherwise identical, and by placing them in mutual magnetic inductive relationship. Our main reception could then be made by the usual type of loose-coupled coils, and if a very strong local station persists in breaking through all the four tunings, it might be possible to get rid of it by pushing the coils of (*c*) closer together. I have not yet had the time to try this and put it forward as a suggestion. Perhaps those in the shadow of **GFA**, may find the time and the desire to experiment in this direction.

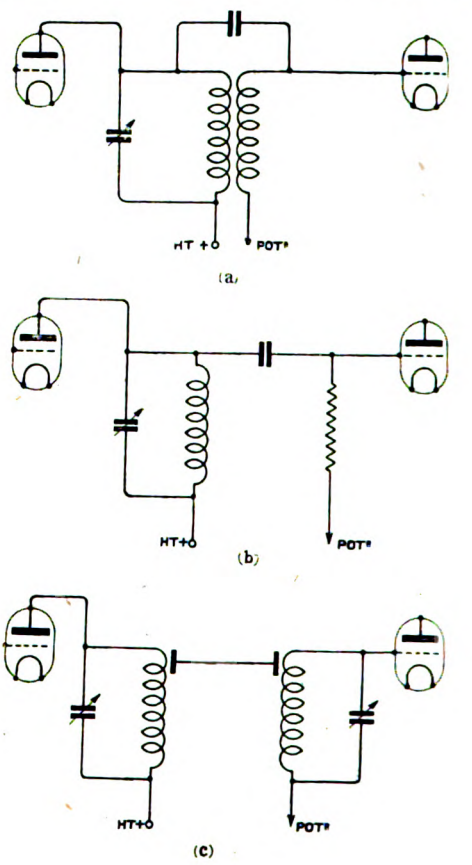
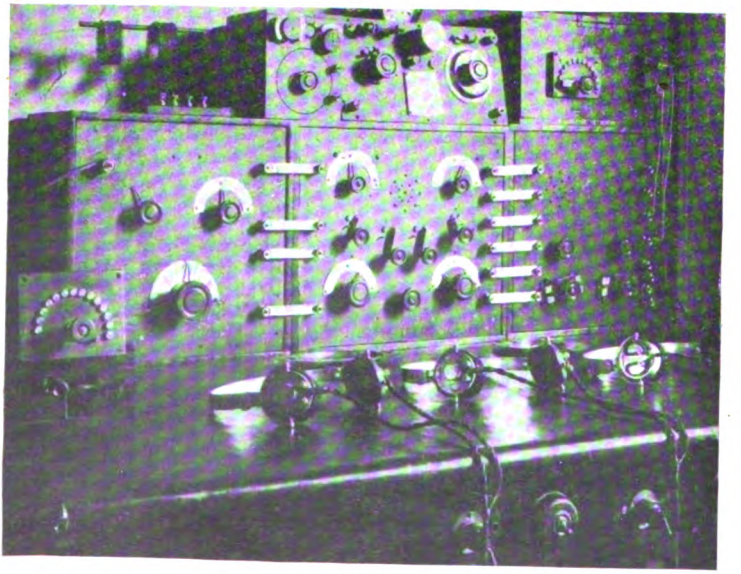



*Fig.* 6.



## A Liverpool Amateur Station

By C. G. WILLIAMS

The general arrangement is shown in the accompanying photograph. The panel on the left is the tuner and by means of fifteen honeycomb coils covers a range of wavelengths from 200 to 35,000 metres. A Townshend wavemeter seen above the tuner is useful for finding adjustments up to 3,000 metres. The detector panel is in the centre and is provided with a number of adjustments giving critical control. On the right is a two stage low frequency amplifier. Other than the telephone receivers all of the apparatus is homemade. The outfit gives very good results, the longest range being **NPO** 9,000 miles away.

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# Notes on the Design of Closed Coil Receiving Sets*

By J. HOLLINGWORTH, M.A. (*of the National Physical Laboratory*).

THE use of a closed coil and amplifier for reception, often a very convenient method where space is a consideration, involves, if efficient working is to be obtained, many problems, some of which are not always fully appreciated. Limitations are, of course, often imposed by the space or apparatus available for the purpose; but if this is not the case there is a very wide range of possibilities, and it is important to make a correct choice.

Generally speaking, the rule has been to use as large a coil as space would permit, with as many turns as possible, in order to pick up the maximum amount of energy, and to use stranded wire in order to reduce the resistance loss.

It is often noticed that such coils do not come up to expectations, particularly in the matter of stranding. The type of wire employed sometimes does not appear to make any difference at all to the strength of the received signals. Also it is not easy to tell whether the coil is working efficiently on all wavelengths. It is possible to make adjustments so that maximum signal strength is received from any particular station, or even from all required stations, but this is in itself no test of whether the coil is giving the best possible result at all wavelengths for a given e.m.f. induced in it.

Measurements of amplification on the amplifier alone are liable to give meaningless results when applied to a coil set; the coil and amplifier are one unit and cannot be dealt with separately. Figures obtained for the amplifier alone cannot be applied to the complete set without making sure that the constants of the coil are unaffected by the inclusion of the amplifier. This may be stated in another way by saying that it is impossible to neglect the power absorbed by the amplifier. It may be, and generally is, extremely small, but it must be remembered that the volts applied to the amplifier are produced by the resonance of the receiving inductance, and so may be several hundred times greater than the actual induced e.m.f. Losses produced by these resonance volts will, in consequence, have a correspondingly great effect on the circuit.

It is often assumed that, provided the grid of the first valve is made sufficiently negative, amplifier losses can be disregarded. In as far as they are caused by steady grid current this is true, but the latter may not be the only, or even the chief source of loss.

The problem of these losses was not originally undertaken as a separate investigation. It arose out of experiments made to determine by means of a coil and amplifier the potential gradient produced by a distant transmitting station. In the course of this work it was found that the discrepancies between the measured and the calculated results were so great that it was essential to enquire into their cause and possible elimination.

The method of measurement was in brief as follows:—A coil and condenser of known values were connected in the ordinary way to a four-valve resistance amplifier, and the effect of the incoming signals on the latter measured. The receiving set was then disconnected, and the amplifier joined to a local calibrated circuit, oscillating at the same wavelength, by means of a variable aperiodic coupling, which was then adjusted until the effect on the amplifier was the same as before. It was the fact that this coupling was aperiodic which brought out the effect.

In the usual method by which the known oscillation is induced directly into the receiving circuit, the term involving the resistance of this circuit does not appear in the subsequent calculations. The aperiodic coupling had been deliberately adopted so that there should never be more than one tuned circuit in existence at the same time. The e.m.f. induced in the receiving coil is in this case calculated as follows:—Since the two circuits produce the same effect on the amplifier the e.m.f's they impress on its terminals must be the same. From the calibrated circuit the value of this e.m.f. $E$ say, could be found. Then if $L$ is the inductance of the receiving coil, $S$ the tuning capacity and $R$ the resistance of the circuit (assumed to be entirely in the coil), the actual e.m.f. induced in this coil by the incoming waves is

$$\frac{ER}{\sqrt{R^2 + p^2 L^2}}$$

(In general $pL$ is large compared with $R$ so that this reduces to $\frac{ER}{pL}$

As a test of this, e.m.f.'s of known value were induced in the receiving coil from another oscillating circuit about 30 feet away, arranged in such a way as to permit of easy calculation of the mutual inductance. They were also measured by the method described above, with the following results (see Table 1), showing that actually a very small percentage of the received energy was being usefully employed.

A further series of tests using currents of sufficient size to give direct readings on a reflecting thermo-galvanometer, showed that these losses occurred as soon as the filament current of the amplifier was switched on, showing that the trouble was in the amplifier itself.

Making the grid of the first valve more negative

* Received April 24th 1922, and published by permission of the Radio Research Board.



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TABLE I.

| Wavelengths metres. | Ratio $\frac{\text{measured e.m.f.}}{\text{calculated e.m.f.}}$ |
|---|---|
| 2,500 | 0·038 |
| 4,000 | 0·091 |
| 5,000 | 0·18 |
| 8,000 | 0·39 |

only reduced the effect slightly, and it could also be seen from the slope of the grid characteristic curve that grid current effect could not account for losses of this magnitude.

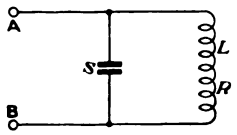


*Fig.* 1.

Now in the circuit of Fig. 1 if an oscillating e.m.f. $E$ be induced in the coil and the circuit tuned, the current is $E/R$. If a high resistance $R_1$ be then connected between A and B two effects occur.

(1) The set requires slight re-tuning.

(2) The current in the coil decreases considerably. With quantities of the order involved in this problem (1) is negligible, but assuming the re-tuning to be carried out the current becomes :—

$$I = \frac{E}{R + \frac{L}{SR_1}}$$

Now most coil sets are tuned by varying $S$, keeping $L$ constant, so it is convenient to eliminate $S$ from the above. If $R_1$ is large we have very nearly

$$LSp^2 = 1$$

Hence

$$I = \frac{E}{R^2 + \frac{L^2p^2}{R_1}}$$

*i.e.*, the set behaves as a simple circuit with an effective series resistance.

$$R + \frac{L^2p^2}{R_1}$$

Under wireless conditions $Lp$ is usually large (in this case it is 3,400 at 2,500 metres) so that, even if $R_1$ be of the order of a megohm the second term may swamp the first term $R$, which is the normal high-frequency resistance of the wire forming the coil. (Incidentally this shows that insulation resistance may be an important factor in all circuits involving high frequency oscillations.)

There appears very little doubt that this is often the cause of no visible improvement being effected by stranding the wire, since the wire resistance may only be quite a small part of the total effective resistance. Curve C (Fig. 2) gives the apparent resistance of the circuit as calculated from Table I, and this works out to be roughly equivalent to a resistance of 50,000 ohms between the grid and filament of the first valve. Now the loss due to grid current was found from the grid characteristic to be certainly the equivalent of not less than 500,000 ohms ; so that this can only have contributed to the loss in a small degree as confirmed by actual experiment. But it has been shown by Miller (*Scientific Papers of the Bureau of Standards*, No. 351, November, 1919) that it is not possible to neglect the inter-electrode capacities of a valve, and that the general effect of them is to transfer some of the energy supplied to the grid circuit into the anode circuit, where it may be dissipated. In general he shows that a valve with a resistance in the anode circuit can be represented as regards the grid circuit by a resistance in series with a condenser, while a valve with an inductance in the anode circuit is equivalent to a condenser in series with a negative resistance which may lead to regeneration, though in the latter case the equation for an inductance to give regeneration is not always soluble in real terms.

Formulæ are deduced for calculating these quantities. Now these inter-electrode capacities are very small, of the order of 5 to 10 micromicrofarads. They are in consequence liable to considerable variations, depending not only on the design of the valve, but also of the valve-holder, and to a certain extent on the general layout of the amplifier. Thus their effect cannot be predetermined to any high degree of accuracy. Typical curves are given by Miller which show that for an

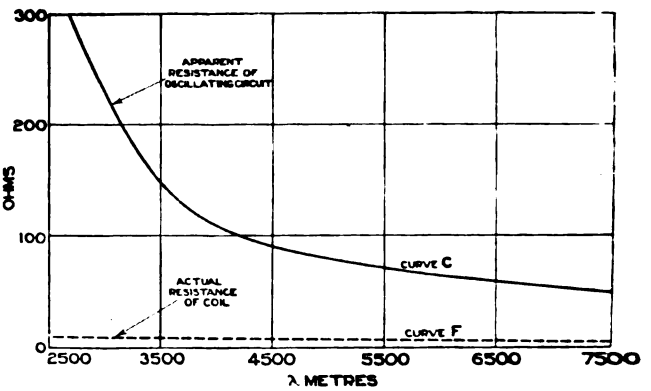


*Fig.* 2.

anode resistance of 90,000 ohms as used in these tests the equivalent capacity and series resistance are about 85 micromicrofarads and 10,000 ohms respectively. This agrees fairly well with the figure of 50,000 ohms with no series capacity given above. If this be the correct explanation it should be possible to eliminate this effective grrid leak by inserting inductance in place of the resistance in the anode circuit of the first valve.

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The general implication from Miller's results is that a transformer amplifier should be used; but there are objections to this in some cases. As is well known with such amplifiers, there is the problem of stability, which is of maximum importance wherever measurements are involved. Also a transformer amplifier can be made extremely efficient for one particular wavelength range, but the falling off in amplifying power with increase of wavelength is very serious. A resistance amplifier on the other hand increases in amplifying power as the wavelength increases, but has the trouble of large losses at the lower end of its range. As the trouble is, according to Miller, principally due to the anode circuit of the first valve, the compromise suggests itself of using a transformer between the first two valves and leaving the remainder resistance coupled. The amplifier was accordingly reconstructed on these lines.

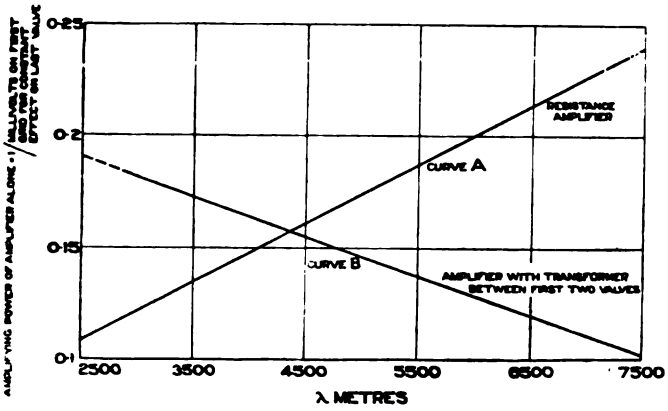


*Fig.* 3.

The effect of the alteration on the pure amplifying power is shown in the curves A and B (Fig.3), the ordinates being the reciprocals of the voltage required to maintain a constant effect at all wavelengths on the last valve of the amplifier.

It will be seen that in the reconstructed amplifier the amplifying power is greater than that of the original for wavelengths below 4,400 metres, but less above this value. But when connected to the coil set the difference between the new and the original arrangements is very great.

At 2,500 metres the set oscillated but could be stabilised by the insertion of resistance. At higher wavelengths this was unnecessary, and the apparent resistance fell to practically the high frequency resistance of the coil (curve E, Fig. 4). Comparing this with curve C (Fig. 2), it will be seen that, even if considerable resistance be deliberately inserted for the sake of stability, the gain is still very large, except perhaps at the top of the wavelength range. On 2,500 metres the set was perfectly stable, with an added resistance of 54 ohms, and with 24 ohms was moderately so, though not enough for the particular purpose required.

The total result on the whole set is given by curves D and E (Fig. 4), which show the e.m.f. which must be induced in the coil at various wavelengths to produce a constant effect on the amplifier. It will be seen that with the reconstructed amplifier the overall efficiency only varies in the ratio of 1 : 2 between the working limits; whereas the variation with the original amplifier is about 1 to 5, and the new one is more efficient throughout. About 8,000 metres the original certainly comes out more efficient, but if much work had to be done at wavelengths above this value it would be preferable to use another coil with a larger number of turns, and possibly a different transformer in the amplifier.

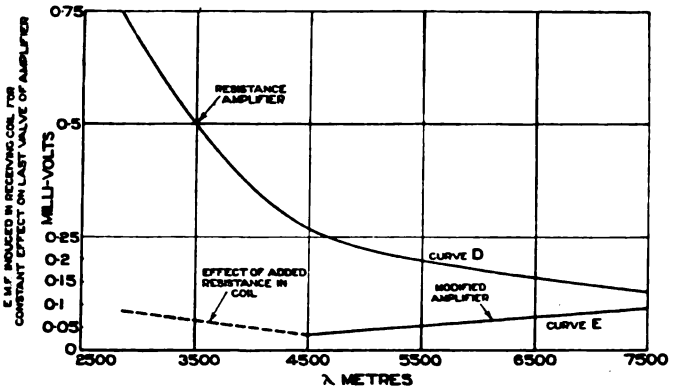


*Fig.* 4.

*Effect of these results on the Design of Coil Sets.*

The first deduction from these results appears to confirm the idea that within reasonable limits the size of wire on the coil is a matter of minor importance. It is evident that it only becomes a deciding factor when the losses in the amplifier are negligible. This implies a transformer at any rate between the first two valves, and if this be designed so as to make the apparent resistance of the set practically zero, the set will be extremely unstable and liable to oscillate at the least provocation.

Moreover, the apparent resistance of such an amplifier is slightly dependent on wavelength, so that even if it were possible to design the set so as to have the apparent resistance a definite small positive quantity (which would be very difficult since the quantities involved are not known to a high degree of accuracy) the amplifier would

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probably require readjustment for each wavelength.

For reliable stability it appears that a certain amount of resistance is necessary, which may just as well be incorporated in the wire as added separately.

Where a transformer is used, even if the apparent resistance of it is intentionally kept slightly positive, it is evident that there will not be the same objection to working near the lower limit of the wavelength range as in the case of the resistance amplifier. A complication is, of course, introduced by the self capacity of the transformer winding, which may tend to produce instability at some particular wavelengths.

The main object in design is to keep $R + \frac{L^2 p^2}{R_s}$ as low as possible consistent with satisfactory working. This involves so many options that it is impossible to give a general rule. It is, however, evident that it is always an advantage to use coils of as large an area as circumstances will permit, as by doing this the ratio area-turns/inductance can be kept up, and consequently larger induced e.m.f.'s obtained for a given value of $L$.

With a pure resistance amplifier as large a value of tuning capacity as possible should be used as until $\frac{L^2 p^2}{R_s}$ comes down to the order of $R$ the inevitable loss of area-turns is more than compensated for by the reduced apparent resistance.

*November 18th*, 1921.

# Wireless and Crime

## THE VALUE OF THE WIRELESS TELEPHONE AS AN AID TO POLICE INVESTIGATION

ON Friday, June 2nd, a demonstration of the possibilities of the wireless telephone as an aid to the police was given at the Annual Meeting of the Chief Constables and Police Representatives of England and Wales held at the County Hall, Spring Gardens. The demonstration was organised by the *Daily Mail* and the technical side was conducted by the Marconi Company, transmissions taking place from their station at Marconi House. The demonstration consisted in despatching from Marconi House (which for the purposes of the experiment played the part of transmitting and receiving station) messages to a detective officer somewhere in Essex, who used a portable receiving station, the instruments being packed away in a small suitcase and the aerial supported by a fishing-rod.

The programme consisted in the transmission from Marconi House of messages to the detective officer in Essex, who, of course, represented only one of the whole mobile detective staff of a county or area. The message broadcasted from Marconi House was a description of a man wanted for fraud and the Chief Constables at the County Hall, Spring Gardens, heard this message with the aid of a loud speaker. Shortly afterwards an announcement from Marconi House was also given that the Detective in Essex had received the message in his car and had acknowledged by ordinary telephone. Two messages were put through to the detective in this way and the replies came through by wireless telephone from Marconi House within an extraordinarily short space of time.

Mr. E. Blake, A.M.I.E.E., of the Marconi Company, lectured on "Wireless and Police Work" to the audience at the County Hall and it was whilst this lecture was in progress that the results of the demonstration as it progressed were received by wireless telephone from Marconi House. Mr. Blake in his lecture dealt first in general with wireless telegraphy and telephony in its application to communications and referred to directional wireless and in particular to the work recently disclosed by Mr. C. S. Franklin, at the Institution of Electrical Engineers, in a paper describing short wave directional wireless. Referring to the application of wireless telephony as an aid to the police, Mr. Blake said :—

In the ideal scheme, I suggest, there would be a chief station at Scotland Yard, so equipped that when it is necessary, (as I, a layman in these matters, suppose must be fairly often), it can communicate simultaneously with the office of every Chief Constable in the kingdom. This presupposes a receiver, at least, in every such office, and a detailed scheme for listening-in, or some kind of alarm-bell which would call each constable on duty to the receiver.

Another need, I presume, would be to link up each central police station with the outlying stations in its area. Let us assume that the Chief Office of a police area is equipped with wireless telephone, and further, that it is desired to convey a message to every other police station under the control of that office. Now, if there is available the necessary staff, standing orders can be issued that each outlying office is to "listen-in" on the wireless receiver at a certain time, in order to receive information or instructions, say, the first ten minutes of each hour, night and day. If there is not sufficient staff available at the outlying stations, then there is obviously a need for the installation of an apparatus which, on a signal from the Central Station, will ring an alarm-bell, causing someone to attend to the apparatus at once—just like a doctor who can be called up by wire telephone at any hour of the day or night.

Suppose it is required to ask all the police in a given area to look out for a motor-car with a certain number or of a certain make, or to detain a man with certain characteristics. The Chief Constable's Office will make a signal which will ring a bell in every police station in its area, and then give its instructions by wireless telephony.

Having foreseen the necessity of a calling-up device in connection with any extensive system of wireless telephony the Marconi Company has introduced the Wireless Bell, which is an automatic

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device operated by a distant transmitter and performs in a simple and efficient manner the same function as that of a call-bell on the ordinary land line system. It is insensitive to all signals except those actually intended to operate it.

The "general call" is sent out by one simple movement of a handle. When the signal is completed the handle reverts to its original position without human assistance.

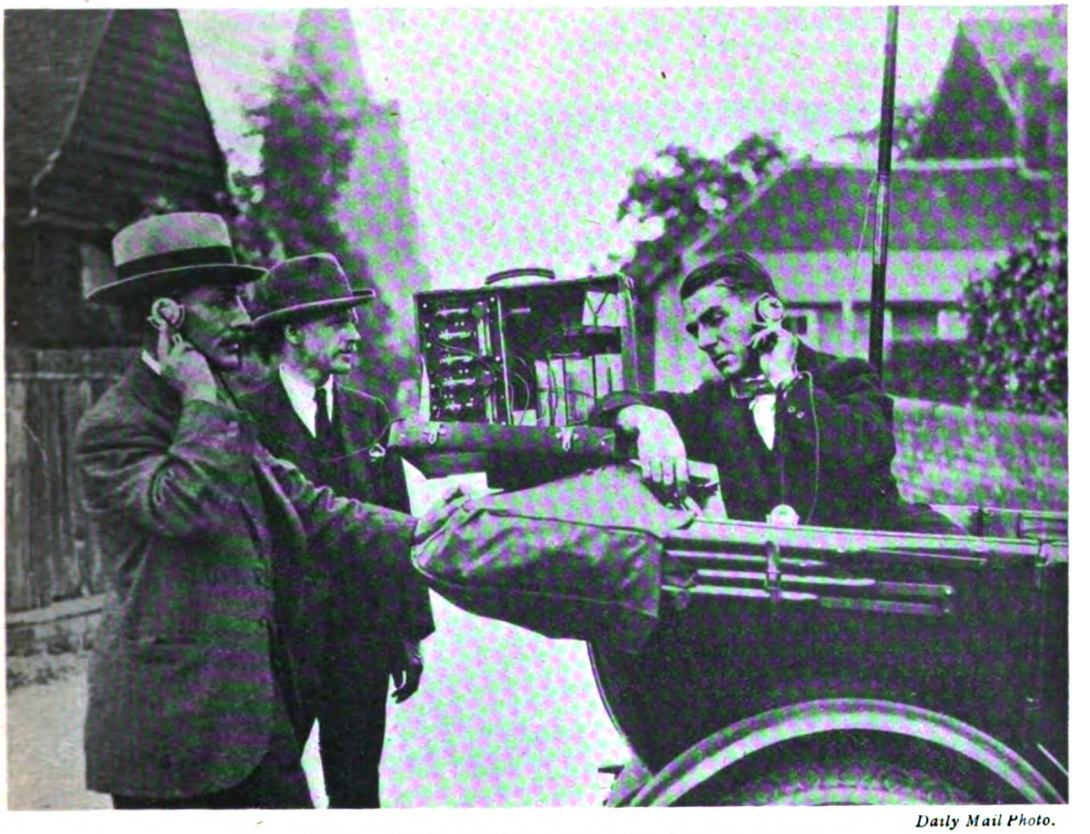
At the receiving end, the receiving telephones are hung on a special rest, this automatically putting the call-receiver in a stand-by position, ready for registering a call.

In brief, the arrangement I have outlined would permit Headquarters to get as many constables as it wanted on the road in five minutes from pulling the handle of the call-bell transmitter.

For more than a year this system has been in use between the offices of the Mersey Docks and Harbour Board in Liverpool and the Bar Lightship outside the mouth of the Mersey.

Another possible system would be the installation of the Marconi Duplex Wireless Telephone. This system permits of uninterrupted conversation between two stations, just as in line telephony. In simplex wireless telephony, neither party can break in on the other. One party speaks and ends by saying "changing over." He then switches over to receive, whilst the other party switches over to "send," and when he desires a reply he also says "changing over" and the reversal takes place again. But a Duplex system allows for a rapid and unhampered conversation without the necessity of constantly switching over between "send" and "receive."

The operation of the apparatus is extremely simple and "fool-proof" once the set has been installed by a competent engineer. Means can be provided whereby complete control of the set is effected from any distance up to about 50 yards,



*Daily Mail Photo.*

*Receiving the Broadcast message in an Essex village.*

When the call signal is sent from the central station the call-bell is set in motion and continues to ring until the telephones are removed from the hook, whereupon the "call" receiver will automatically be put out of action until the telephones are again hung up.

Assuming that all the call-bells have been actuated and attended to, the central station would then proceed to broadcast its message in the usual way. Acknowledgment of the message would, or could, be sent back to Central by each station in order, according to service instructions, which would have to be worked out in detail when the system is installed.

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thus eliminating the noise of running machinery. In this case the only apparatus required at the operating table consists of the headgear telephones, the transmitter and one switch.

The range obtainable is dependent upon local conditions and the power input. In most cases, however, a range of 20-30 miles may be expected, these figures being well exceeded under favourable conditions. As an example, if the range is about 20 miles, a simple sum in mensuration shows that the station can operate over a roughly circular area of about 1,200 square miles. Sets operating with higher power, can, of course, be designed.

So far we have explored only the possibilities of fixed stations. Let us now consider a system consisting of one fixed station and any number of mobile stations. As I have explained, the power of the fixed station determines the extent of its effective working area. In any case we may assume that the mobile stations would be equipped with receivers of sufficient delicacy to meet all the demands of the particular service they would be called upon to perform.

The requirements of the fighting services, especially during the war, have been such that efficient, simple, robust, self-contained, wireless sets have been fitted to well-nigh every kind of vehicle, to pack-animals, aeroplanes, submarines, and to the man himself. I do not think, however, that a wireless telephone transmitter has been adapted for human portage; to fit a receiver to a man, is, however, simple.

For police work telephone sets, both for sending and receiving, can be fitted in motor-cars or to motor-cycles with side-carriers. For reception, only light portable frame or fishing-rod aerials can be carried with ease; for sending, it would be necessary to have the aerial wire on a reel, as in aeroplane sets, so that it can readily be unwound and the end elevated to a tree or lamp-post. You will probably recall that a few years ago the Marconi Company demonstrated for the London Fire Brigade how a set carried on a motor vehicle can get into touch with its headquarters within a few minutes. The car was driven to Putney Heath, the aerial was tied to a convenient tree, and excellent wireless telephone communication was established with a fire station at Southwark. During its return journey, the car was run up a side street, the aerial tied to a lamp-post and communication again established with Southwark.

*Daily Mail Photo.*

*The Portable Set with "fishing rod" aerial in use in rural surroundings.*

On one occasion it was demonstrated how a motor-bus could tour the Essex roads with a frame-aerial fastened outside it, flat against the body: music and speech were well received from Chelmsford whilst the bus was in motion.

The adaptation of wireless telephone sets to vehicles presents no special difficulties now; indeed the problem has already been solved for most cases.

The so-called "pocket sets," I regard as interesting toys. Certainly it so happens that I have never used one, and I am not in possession of any information as to the success with which they have met in the hands of the Chicago

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police, who are reported to have tried them. The possibilities of a suitcase set have already been demonstrated, but then the carrying of a suitcase reduces the mobility of the carrier.

The specification that the set has to be highly portable—worn like a knapsack as a part of the normal equipment—at once determines several other things. For instance, it means that the aerial must be small, and the smaller the aerial the less electrical energy it can pick up. If we wish to counteract that drawback by making the receiver more powerful, we are again confronted by difficulty, for if the receiver is not to be an intolerable burden to the man, it must be light and small. Unfortunately, the more powerful the receiver the larger and heavier it is likely to be. Boiled down, these considerations show that the designer of the set would have to strike a mean between its performance and its portability. Probably the reception range of a "pocket set" would be little more than a mile or two, and there would be no possibility of the user acknowledging the message. Speech could be heard, however, over a distance of 30 miles, on a portable receiver weighing not more than 10 lbs., using a fishing-rod as an aerial. The rod could be 15 feet long when open and three feet long when closed. For this the power of the transmitting station would have to be about 1½ kilowatts. A receiver of this weight would, I presume, be too heavy to form part of the regular kit, but would be quite suitable for special excursions, when an officer had to report to headquarters after investigating a case.

With a fairly cheap, simple, light receiver, however, such as might be carried in a leather case by slings, after the manner of binoculars, it would be possible to receive messages from ten miles or so, if a large aerial were available. To meet this difficulty I suggest that it would not be at all impracticable to erect special "police aerials" in various parts of a large town and at suitable places along country beats, all of which would be known to each officer. Standing orders might provide, for instance, that every officer on duty shall "listen-in" at the nearest aerial once every hour, or two hours in districts where the aerials are more scattered. The aerial and earth terminals would be placed in a small locked box attached to the aerial pole and each officer would have a key. All he would have to do would be to open the box, connect the aerial and earth terminals to his receiver by means of two brass plugs, and listen in his telephone receiver for the stated period—say, five minutes—afterwards re-locking the box.

It is only by some such arrangements, I think, that a very small light receiver could be made of real use. The idea I have just explained might be extended to permit officers on duty to converse with headquarters, by setting up the aerials and small huts like the Post Office public telephone boxes, containing a wireless transmitter. That is quite a practical suggestion, though costly to carry out.

I now come to what, in my opinion, is the root of the whole subject. Wireless telephony conversation can be intercepted not only by those legitimately concerned, but by anyone else within range, including criminals and their accomplices and tools. Innocent amateurs within range would overhear police instructions and would be tempted to gossip or flock down to the scene of the crime. The veil of secrecy behind which the police work would be rendered rather transparent by wireless telephony. Only routine matters and others of no particular secrecy could be confided to the æther. You yourselves are the best judges of what should be broadcasted, but there would probably be scope for grave errors of judgment on the part of your subordinates.

What then is the way out of the difficulty? I can only offer a partial solution of the problem. You can have recourse to code, but that would prohibit conversation, or, at best, would render conversation slow in the extreme. Instructions needing no reply, however, might be in spoken code, which could be changed from time to time. You might transmit on a wavelength such that the number of casual listeners who might hear you would be very small. But the use of code and wireless telegraphy instead of telephony, so that Morse code signals instead of speech is transmitted, would ensure much more secrecy, because it is certain that in future the majority of people holding licences for wireless reception will be unable to read Morse, having acquired their instruments solely for the purpose of listening to wireless telephony concerts.

Where, however, the police authorities desired the fullest publicity and wished to enlist the help of the public, descriptions of "wanted" persons could be broadcasted by telephony far and wide and would inform thousands of people who might miss the same printed in the newspapers. In this case, in fact, wireless might leave the fugitive from justice very little chance indeed.

## The Size of Wire to Use

THE inexperienced constructor should remember when deciding the size of wire for his tuning coils that what he must seek to achieve is a satisfactory compromise between the two opposing considerations of efficiency and compactness. The finer the wire used, the smaller the coils, but also the higher their resistance, and therefore the greater the damping of any tuned circuit in which they are connected. Now damping is a great enemy to efficiency, for it reduces not only signal strength but also the sharpness of tuning, thus increasing trouble from jamming. Hence the importance of the satisfactory compromise.

The actual gauge of wire to use depends to some extent upon wavelength, since short wave coils are not very large and can therefore be wound with wire almost as thick as one chooses, while a thinner size must be used for the long wave coils, lest they become excessively bulky. Suitable sizes for aerial circuit coils are as follows:—

| | | | |
|---|---|---|---|
| 300 to | 1,000 | metres, | No. 20 or 22. |
| 1,000 „ | 4,000 | „ | „ 24 „ 26. |
| 4,000 „ | 20,000 | „ | „ 28 „ 30. |

Secondary circuit coils:—

| | | | |
|---|---|---|---|
| 300 to | 1,000 | metres, | No. 22 or 24. |
| 1,000 „ | 20,000 | „ | „ 28 „ 30. |

Reaction coils, No. 30 for all waves.

Where compactness is particularly desired, use the finer of the alternative gauges, and where efficiency is the first consideration, use the thicker.

G. P. KENDALL.

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# Time Table of Transmissions of the Eiffel Tower Wireless Station.

The Eiffel Tower gives continuous wave transmissions with a certain number of European Correspondents. The service is conducted in duplex, reception by the Correspondents being checked by the Central Military Listening Station of Nogent le-Rotrou or the Central Listening Station of the Administration of Posts and Telegraphs, at Villejuif.

The times of these transmissions are given in the following table, together with those conducted on spark.

| Times of Transmission G.M.T. | Type of Transmission from Eiffel Tower. | Call Sign of Correspondents. | Type of Transmission of Correspondents. |
|---|---|---|---|
| 0220 | 2,600 metres Spark | C Q (Meteorological message for France) | |
| 0300 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 0415 | 3,200 metres Arc | Naval Stations | |
| | | FUD (Dunkerque) | 1,350 metres Spark |
| | | FUC (Cherbourg) | |
| | | FUN (Lorient) | |
| | | FUR (Rochefort) | |
| 0420 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 0700 | 3,200 metres Arc | Naval Stations | |
| | | FUE (Brest) | 4,500 metres Arc |
| | | UA (Nantes) | 6,750 metres Arc |
| 0820 | 2,600 metres Spark | C Q (Meteorological message for France) | |
| 0835 | 3,200 metres Arc | PRG (Prague) | 1,700 metres Valve |
| 0923 | 2,600 metres Spark | C Q ordinary international time signals (automatic) | |
| 0958 | 2,600 metres Spark | C Q Scientific time signals (beats) | |
| 1033 | 2,600 metres Spark | C Q URSI signals and semi-automatic time signals (French) | |
| 1100 | 8,000 metres Arc | NTT (American ship in the Black Sea) | |
| 1130 | 2,600 metres Spark | C Q (European meterological message) | |
| 1205 | 3,200 metres Spark | C Q (Press) | |
| 1300 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 1420 | 2,600 metres Spark | C Q (Meterological message for France) | |
| 1500 | 6,500 metres Arc | BUC 2 Bucharest | 7,300 metres Arc |
| 1705 | 3,200 metres Arc | Naval Stations | |
| | | FUA (Bizerte) | 5,150 metres Arc |
| | | FUT (Toulon) | |
| 1710 | 2,600 metres Valve | Wireless telephony meteorological forecast | |
| 1745 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 1920 | 2,600 metres Spark | C Q (Meteorological message for France) | |
| 2130 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 2158 | 2,600 metres Spark | C Q (Scientific time signals) | |
| 2205 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 2236 | 2,600 metres Spark | C Q (Semi-automatic time signals) | |
| 2250 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |
| 2315 | 8,000 metres Arc | UAB (Beyrout) | 6,100 metres Arc |
| 2325 | 6,500 metres Arc | BUC 2 (Bucharest) | 7,300 metres Arc |

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# How to get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.

(Author of " The Maintenance of Wireless Telegraph Apparatus ".)

### (2) CRYSTAL RECEIVERS—*Continued.*

THE carborundum detector will probably be popular in broadcasting receivers. In this a crystal of carborundum is pressed against a piece of polished steel. The pressure in such cases should be quite firm, and the steel surface must be entirely free from rust, dirt and grease. If the steel surface is found to be rusty, it can be repolished with fine emery paper.

The carborundum detector is a very robust device, and if good crystals are used, a high degree of sensitiveness can be obtained. To get the best results a couple of dry cells and a potentiometer are needed, so that the electrical pressure applied to the crystal can be carefully adjusted. A new pattern carborundum detector has recently been devised in which an adjustable potentiometer is unnecessary.

A potentiometer needs occasional attention, and may be the cause of unsatisfactory working. The sliding portion must make good contact with the wire, but must be free from roughness, or the fine wire on which it rubs will soon be cut through. If these points have been attended to and signals are still not satisfactory, a disconnection in the wiring of the potentiometer may be the cause. Dirt and corrosion on the bare wire are also fruitful sources of trouble.

If a crystal receiver is not provided with a cover, never leave it open to the dust. It is well to keep a soft camel-hair brush (reserved for this purpose alone) to remove any dust that may settle upon the crystal surface. For obvious reasons the type of detector which is enclosed has much to recommend it.

Most crystal receivers are provided with a simple tuner consisting of a coil of wire, the number of turns in circuit being controlled either by stud switches or by a slider running over a section of the coil which has been freed of insulation. For fine tuning a condenser may be added. Better sets have inductively coupled circuits, which, again, may have sliders or stud switches on both primary and secondary windings. Usually such sets are fitted with variable condensers. Tuner troubles (apart from disconnections of the wires) usually resolve themselves into imperfect contact between the sliders and the wire, or between the switch blades and the studs. If the slider is not making good contact, it is practically impossible to rectify the fault whilst the slider is *in situ*. Unfortunately, some of the cheapest sets are so made that the removal of such a part is difficult.

Actual disconnections frequently occur at the point where the moving portion of a switch is connected to a wire. In the best sets the connection is made by a rubbing contact. In cheaper sets a flexible wire is simply soldered to the spindle of the switch and is a common source of trouble.

The resoldering of connections in a wireless receiver calls for considerable care. Flux must be used very sparingly, if at all, and must be of the non-corrosive type. In any case it must not be allowed to run over the ebonite or it may form a film which is in effect a high resistance leak and may cause serious loss of signal strength.

There is one particular difficulty connected with the soldering of connections in wireless apparatus which gives much trouble to the beginner in instrument making, and may disagreeably surprise any man who attempts to repair apparatus. If, for example, a switch stud requires a lead soldered to it, use a very hot soldering bolt and apply it to the stud for a minimum of time. If the stud gets thoroughly heated it will probably loosen, no matter how carefully the locknut may have been tightened beforehand. This is due to the softening of the ebonite under heat. The trouble can only be avoided by the method indicated above.

Some cheap receivers have their coils wound upon unsuitable formers which shrink and cause the windings to become loose. This particularly applies to formers of cardboard, which are never satisfactory, save when very carefully baked and impreganted before winding. All good receivers have their coils wound on tubes of ebonite, bakelite, or one of the newer insulating materials which do not shrink. Well seasoned mahogany is also a good material. In cases where the windings become loose, the only satisfactory remedy is to take out the old coil and wind a new one.

From the list of faults indicated above the reader will have gathered that a cheap crystal receiver may prove expensive in the long run. The list will also give some indication of what to look for in choosing a crystal set.

### (3) WANTED: WIRELESS SERVICE STATIONS

Even at this stage of the wireless boom, there is a great need for " wireless service stations " in all the leading towns. Such stations can be easily organised by keen electricians who are also wireless men. I would like to see one such station in every locality where there is a wireless society.

A wireless service station should first of all have full and adequate facilities not only for charging accumulators promptly, but also for maintaining them in good order. At the present time there are a number of garages who will charge accumulators at a reasonable fee, but usually the amateur has to wait his turn, and nothing is more annoying than to be without an accumulator on an evening when a concert is to be broadcasted. The wireless service station must therefore be able to guarantee delivery of the charged accumulator at a definite time.

Two other forms of service are also of great importance. The first relates to the erection and maintenance of aerials (this can probably be arranged in connection with the local builder who will be able to supply ladders, etc.). The second relates to the measurement and calibration of sets with the aid of an accurate wavemeter. Every purchaser of a set needs to know the adjustments for the chief wireless telephone transmitters (English broadcasting stations, Writtle, the Hague, Eiffel Tower, etc.) and these can be indicated for him by the service man with his wavemeter. Other important services will soon suggest themselves to the enterprising man.

(*To be continued.*)

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# Notes

**Transmission of Telephony from Marconi House.**

On Friday, June 16th, a transmission of Wireless Telephony from Marconi House, 2LO will take place at 8 p.m., in connection with a Fête which will then be in progress at Caxton Hall, Westminster.

**Advance in Radio Work in Czecho-Slovakia.**

The Ministry of Post and Telegraph of Czecho-Slovakia has followed all the latest developments in radio, sending engineers to foreign countries to study operating systems. When weather conditions are favourable, a large station will be built at Podebrady, Bohemia, where the natural features are said to be ideal. It is reported that a central and subsidiary wireless system will soon be established.

The main station will be equipped with high frequency generators (Letour-Bethenod type), producing 50 kW in the antennae. The entire station will be able to produce additional energy up to 100 kW in the antennae. If the work demands it, an additional 50 kW set will be installed. Two towers, 150 metres in height, will be erected. It is estimated that the range of the station will be about 4,000 kilometres.

Podebrady station will be the main sending station for Prague, but a small station will also be erected there by the State Post and Telegraph Office, equipped with a valve transmitter.

At Kral Vinohrady, a district of Prague, a radio station with a radius of 400 kilometres is now being operated. At Brunn, Moravia, another station has just been completed and tested.

For communication between Slovakia and Prague, as well as the Orient, a new station is being erected at Kosice, Slovakia, and another, at Bratislave, will be operated for the benefit of the Danube shipping and the International Danube Committee now sitting there.

A station has been projected for Liberec (Reichenberg) and it is hoped that it will be completed by August 20th.

Because of the importance of radio communication to aerial navigation, the Czecho-Slovakia Ministry of Post and Telegraph and the Ministry of National Defence are now building a station with a range of 1,000 kilometres at Kbely, near Prague, the starting point of aeroplanes for Paris and Warsaw. In Western Bohemia, at Plzen or Cheb, a station for operation in connection with the air service for Paris will also be established, and another in North-eastern Bohemia for use in connection with the aerial route to Warsaw. The Ministry of National Defence is now proposing to build a system for military purposes only.

**New Wavelengths for Eastern Stations. Clearing the Pacific Air.**

After considerable difficulty in reaching a wavelength which does not interfere with the transmitting of the British and Japanese radio stations on the Pacific, the U.S. Naval Communication Service has determined upon a wavelength of 13,700 for east-bound messages from the Naval Station at Cavite (NPO). A two-weeks' test between Cavite and San Francisco (NPG) showed that with this wavelength the signals from the Japanese station sending from Iwaki did not interfere as was previously the case. Originally the Cavite station sent eastern messages on 14,200 but that interfered with the English stations, and 13,900 was tried out with interference from Iwaki. To-day, however, NPO comes through to San Francisco on 13,700. West-bound messages from San Francisco and San Diego are not sent direct to Cavite, but relayed through Pearl Harbor.

**Direction Finding Stations in the United States.**

It has been unofficially reported that during the past winter fourteen large merchant vessels were saved from destruction by the U.S. Navy's wireless direction finding stations. Due to the severe storms in the Atlantic, ships were often unable to determine accurately their positions on approaching the coast. By simply calling by radio the nearest station and asking for bearings, they were given their positions accurately and it is estimated that fourteen ships thus aided would otherwise have been wrecked.

The U.S. Navy maintains along the coast of the United States 62 D.F. stations and the value of ships saved from destruction during three months of bad weather will more than offset the total cost of installation and maintenance of all the D.F. stations.

**The Townsend Wavemeter.**

On May 15th the Royal Commission on Awards and Inventions heard a claim by Professor J. S. E. Townsend, F.R.S., Professor of Physics at Oxford, in respect of the wavemeter which bears his name.

Evidence was given in support of the claim by Professor Townsend and Professor Whiddington, of Leeds.

The Commission reserved its decision.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—On reading the 20th May, 1922, issue of *The Wireless World and Radio Review*, I have noticed an interesting article, "Listening In," by Mr. J. E. Wilkes. In it the writer goes on to say that while confining his attentions mainly to the use of a 3-valve C Mark III amplifier, he has found it to give excellent results on all normal telephony, barring the Dutch concert. Why does it fall short in this particular case? At the conclusion there is an invitation to compare results.

I too, have a similar amplifier and am able to hear the Dutch concert four feet from the telephones—conditions being normally good.

Being in the Army Signal Service, I have had considerable experience of this type of amplifier.

Should Mr. Wilkes require any information to help him receive the Dutch concert on this amplifier I shall be only too pleased to assist, as it seems to me quite unnecessary to have recourse to a six-valve amplifier for this station when three will answer almost equally well.

N. G. BAGULEY,
Lieut. Royal Corps of Signals (T.)

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*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—While listening on my set this morning (May 30th) about 11.30 a.m., I picked up some telephony in French, which varied from 900 to 905 metres.

I feel sure it was not Le Bourget, nor any other station on the Civil Air Route in France, as the voice was not familiar to me.

The position from here of the transmitter was S.E. by E.

His carrier wave was quite loud, also he was very persistent in calling "Hello" many times, and then started off in French, giving mostly figures, but no call letter, unless I missed it at first.

I should be greatly obliged for any particulars regarding this station (position, name, etc.).

Thanking you in anticipation.

Yours truly.

G. F. ROBINSON.

9, Southgate,

Sleaford, Lincs.

*May 30th*, 1922.

## JAMMING BY VALVE RECEIVERS.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am aware that you have received numerous letters on this subject in the past and must therefore apologise for asking you to publish this further protest against the amazing and unnecessary interference caused by badly handled self-heterodyning valve receivers.

I hope that this letter will reach the eyes of a few at least of the rapidly growing body of devotees to "Reception by howling," which habit, for habit it is, seems to grow on them like drug taking.

Nearly every time I go out in this neighbourhood I see some new amateur aerial in course of erection. I should wish to experience a feeling of pleasure at the advent of a new fellow-worker to the engrossing hobby of wireless, but instead, I find myself anxiously calculating the distance to my own station in fear and trembling that here will be yet one more instrument to be added to the "Jazz Band."

How these offending stations manage to receive telephony passes comprehension. Telephony, obviously, it is to which they are attempting to tune. They can be heard following the conversation of two transmitting stations from one wavelength to the other, the while they keep their sets in a state of continuous and violent oscillation.

"And even spoiled the women's chats
By drowning their speaking
With shrieking and squeaking
In fifty different sharps and flats."

Oh for a "Pied Piper" to quel them!

Even the transmissions of stations such as **2 FQ** and **2 ON**, which approach perfection, and whose volume in this neighbourhood is immense, are considerably marred by this eternal choir of shrill voices.

Finally, I would make an earnest appeal to all amateurs, especially to those who are new to the game, to remember that, badly handled, their sets can radiate very powerfully, which radiation seriously interferes with other stations' enjoyment of some interesting speech or music.

O would some power the giftie gie them
To hear themselves as others hear them.

Please excuse this misquotation.

M.J.G.

Bromley, Kent.

*May 31st*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I should like to appeal to those sending out telephony to state as clearly as possible the name of their town as well as their number or call sign.

Many listening-in with cheap or home-made sets are anxious to know the range of their apparatus and often a concert will be heard, but to catch the two letters of the sender correctly is often impossible.

I heard a gramophone concert being given to Walthamstow. The sender called up Walthamstow but only gave his call letters, which I could not get. I have looked through the Wireless Year Book for some of the letters I thought it might have been but it was evident that I had not got them anything like right.

Now if he had stated the name of his town I could have no doubt got it as I could hear his speech fairly plainly.

GUY WILLIAMSON.

Bromley, Kent.

*June 7th*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I should be grateful if you could find space in the *Wireless World and Radio Review* for the following:—

The reception of Chelmsford Concerts on 400 metres: On Tuesday, May 23rd, I was delighted to hear the operator at Chelmsford inform all who were listening-in, that on May 30th the transmission of music and telephony would be on 400 metres, this, he said, was not only to get rid of jamming from a spark station, but to give more people the pleasure of listening-in.

Alas! The 400 metres transmission began this evening, and although the Marconi music and speech was just as good as ever, there would be few of the Potteries Amateurs who would have the pleasure of hearing it through. This state of affairs being entirely due to many, either ignorant or indiscriminating amateurs allowing their sets to keep up a continuous howl, apparently by reactance methods. Immediately one got the set off the oscillation point and was receiving the concert nicely, in would come a terrific howl, as strong as Marconi's carrier, and set the whole apparatus oscillating strongly again.

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In the end I switched off in disgust, totally fed up with the jazzing of condenser or reactance howls.

If this is going to be the state of affairs the broadcasting boom is going to reduce us to, I am afraid the enthusiastic experimenter will sell up, and instead of the wonderful science progressing it will be a dismal failure. As I have said before, perhaps the offenders are ignorant of the fact that while they are attempting to time-in they are stopping many others from getting good results.

It was far preferable to get jammed out with a spark station than to have a jazzy band of disturbance.

My advice to a beginner in the Potteries is to join the Potteries Wireless Society and learn something of the apparatus before making a dismal failure of the whole district; we are sorely troubled with power strays, and have enough to contend with in that respect.

Thanking you in anticipation.

Yours faithfully,
P. E. BANKS,
*Hon. Secretary,*
N. S. Rly. Wireless Society.

Headquarters:
Elec. Dept., Stoke Station.
Club night, 7 p.m. Wednesday; open to railway employees only.
Stoke-on-Trent Society headquarters: 6, Liverpool Road, Burslem. Open to all.

# Book Review

THE A.B.C. OF WIRELESS: A Popular Explanation. By Percy W. Harris. (London: *The Wireless Press, Ltd.* Pp. 64, illustrated. Price 6d. net.)

This little book has been specially written to meet the requirements of those who, without having had any experience in wireless matters, wish to acquaint themselves both with an introductory knowledge of the subject and with what has been accomplished by the science from its earliest discovery up to the present time.

The opening chapter deals with a consideration of the ether and waves in various mediums and describes how the experiments of Hertz led on to the beginnings of wireless telegraphy.

Subsequent chapters deal with the gradual development of wireless telegraphy, describing the early work of Branly, Lodge, and Marconi. Methods of tuning and detecting wireless waves are explained, after which are considered in turn the three-electrode valve, continuous wave telegraphy and wireless telephony.

The concluding chapters are devoted to an explanation of how to proceed to take advantage of the facilities now offered to the public to participate in the service which wireless can give.

Within its sixty-four pages it may be said that this little booklet gives a complete introduction to wireless, forming the basis for further study, whilst those who do not wish to go deeply into the subject will find that by carefully reading through this attractively written little volume they can acquire a very sound general knowledge of what wireless really is, its history and its future possibilities.

# Calendar of Current Events

**Sunday, June 18th.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, June 20th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT**, Writtle, near Chelmsford.

**Thursday, June 22nd.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

Demonstration of the Ultra IV Receiver by Mr. F. O. Read, Member I.R.E.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Extraordinary General Meeting to consider Club's wireless telegraph set and transmitter, Club's Quarters and subscriptions, arrangements for Summer Season, and any other business.

**Friday, June 23rd.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. Lecture and Demonstration:—"The Construction of a Valve Receiving Set" (Part I), by Mr. F. L. Hogg.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Discussion on Direction Finding.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston. "Experiences as a Wireless Telegraph Operator," by Mr. F. Harrison.

**Saturday, June 24th.**

WIRELESS SOCIETY OF HIGHGATE.

Field Day. Outing to Ken Wood.

**Sunday, June 25th.**

Transmission of Telephony from the Hague, **PCGG**, as above.

**Tuesday, June 27th.**

Transmission of Telephony from Writtle, **2MT**, as above.

**Friday, June 30th.**

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part III, by Mr. J. Stanley.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.*—[ED.]

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### North Middlesex Wireless Club.*

The 92nd meeting of the Club was held at Shaftesbury Hall, Bowes Park, N., at 8 p.m., when the Chair was taken by the President, Mr. A. G. Arthur. After the minutes had been read by the Secretary, the Chairman, after a few remarks, called on Mr. D. Macadie to give his lecture on "Direct Current Measuring Instruments, their Design, Construction and Use."

Mr. Macadie had brought to the Hall a large number of measuring instruments, both ancient and modern. These were displayed on the lecture table, and made a fine and imposing show. He started with the ordinary linesman's galvanometer, and explained the various types that were in use. The lecturer said that it was now considered preferable to use instruments that read direct in volts or amperes to an instrument that gave a purely arbitrary reading, and showed examples of these instruments of the moving coil, hot wire, and the electrostatic types, and by means of large clear diagrams attached to the blackboard he explained the characteristics of each.

He then passed on to the measuring of resistance, and explained in detail the principles of the well-known Wheatstone Bridge and the method of using it. His description of the way in which plugs were removed in certain ways, which had the effect of inserting various resistance coils of known value, and enabling readings to be taken over a large range, was followed by members with great interest. Mr. Macadie then explained the action of the Megger testing generator, and on the suggestion of Mr. Holton, the Club's aerial was tested as a demonstration, and it was satisfactory to learn that the resistance was all that could be desired.

A very interesting instrument was the "Avometer," which was one of Mr. Macadie's own design. By an ingenious arrangement it was made to read amperes, volts and ohms, as required. The instrument was of neat and compact design, and was much admired.

The Chairman moved a vote of thanks to the lecturer, which members responded to in a hearty fashion.

New members continue to come along, and full particulars may be had on application to the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

### Sussex Wireless Research Society.*

Hon. Secretary, Mr. Edward Hughes, B.Sc., A.M.I.E.E., The Technical College, Brighton.

The above Society held its last meeting of the present session at Cottesmore School, Hove, on Wednesday evening, May 31st. A statement of accounts was submitted by the Hon. Treasurer which showed that the Society was in a very satisfactory position financially. After the discussion of various business items, the President, Capt. Hoghton, F.Inst.P., gave a short lecture on the electronic theory of matter, explaining in particular the application of this theory to the production of electromagnetic waves.

### The Wallasey Wireless and Experimental Society.*

At the meeting of the Society held on Thursday June 1st, the Secretary gave a short lecture on "Landline Telegraphy."

He dealt with the progress of an ordinary commercial telegram from the time of handing in to its final transmission along the submarine cable and gave a short description of the instruments used at each stage.

The Society still has room for a few members, and the Secretary will be pleased to forward full particulars to anyone who wishes to become a member.

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

### Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A General Meeting was held on May 26th at the Leeds University, Mr. G. P. Kendall, B.Sc. (Vice-President), taking the Chair at 8 p.m. The Chairman called upon Mr. T. Brown Thomson to deliver a lecture entitled "Types of Valves."

Mr. Thomson commenced his paper with an exposition of the electron theory of matter, showing its particular applications to the study of vacuum tubes as used in wireless work. He emphasised how important it is that the amateur should fully understand what his valves require to work most efficiently, *i.e.*, different valves require different voltage and current values, etc. He then explained the two main properties valves possess, these being their uni-directional conductivity and non-uniform conductivity. Two electrode valves or diodes were then considered, the characteristic curve of these tubes being examined carefully. The lecturer then explained the three-electrode or triode valve, showing very clearly the function of the third or control electrode. Characteristic curves of various triodes, including the French "S" valve, the British "R" and "Q," the German A.E.G. type, and the De Forest Audion valves, were shown, explained, and compared in detail.

At the close of Mr. Thomson's remarks the Chairman declared the discussion open. Some very interesting points bearing on the electron theory were examined still further, the effect of potential drop along the valve filament and the filament current's electro-magnetic effect on characteristic curves were touched upon. After the discussion had closed, a hearty vote of thanks was accorded to Mr. Thomson, for the very interesting and instructive lecture.

After certain business had been discharged, the meeting terminated at 10 p.m.

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**Blackpool and Fylde Wireless Society.***

Hon. Secretary, Mr. C. Sheffield Doeg, "The Poplars," 6, Seventh Avenue, South Shore, Blackpool, to whom all communications should be forwarded.

Owing to the large amount of publicity being given to the new scheme of wireless broadcasting by the press, and the great interest taken in the subject by the general public, this Society's membership has within the last few weeks been increased by quite 50 per cent.

Classes are to be commenced in which new members will be taught a number of subjects, of which the following are only a few:—Construction of instruments, fault detection, erection and dismantling of stations, manipulation of sets, etc.

A morse class has been in operation for some time, and those having passed out, are quite capable of passing the P.M.G. transmitting speed test as well as reception.

The Society is divided into two sections, junior and senior, the age limit of 18 being the dividing line, quite a number of ladies are on the register and come in very useful where matters of a social order are concerned, both sections are represented on the Executive Committee amongst whom are two ladies.

The Society, although only 18 months old, is in a fair way to becoming a real asset to the local amateurs, numerous difficulties, necessitating several changes and rearrangements in the personnel of the governing body have been satisfactorily dealt with in the past, and, optimistically speaking, there is nothing but plain sailing ahead.

As the membership increases, so of course does the work, and the Executive Committee expect to have to appoint an Assistant Hon. Secretary very shortly.

The Society draws its support from an area quite as extensive as Manchester, although Blackpool itself is comparatively small in point of acreage, and branches are to be thrown out at suitable places for the benefit of members who otherwise would have upwards of ten miles to cover to attend the weekly meetings at Headquarters.

One of the customs of the Society is to extend a special welcome to members of the other Societies who visit the King of English Watering Places. Mr. W. G. Dixon, a member of the Committee of the Newcastle and District Wireless Association, favoured the Blackpool and Fylde Wireless Society's Hon. Secretary with a visit on May 28th last.

As the summer season is once more almost upon us, the Blackpool and Fylde Wireless Society renew their open and standing invitation to all and every member of other Wireless Societies to visit them when in Blackpool, the address of their Headquarters is the top floor, Café Waldorf, corner Church Street and Coronation Street, and the regular weekly meeting is on Thursdays, time 1930, B.S.T., and they wish every Wireless Society "very good broadcasting."

**Woolwich Radio Society***

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The May monthly meeting of the above Society was held at the Woolwich Polytechnic on Friday, May 26th, at 8 p.m. There was a large gathering of both members and visitors. The meeting took the form of an exhibition of amateur home-made apparatus and there was a large and varied assortment of exhibits, numbering about forty, and including:—A three-valve set, embodying several interesting new features, also an independent heterodyne, which he used as a wavemeter as well, by Mr. Beeson; a three-valve set with tuned anode and slab coils, very neatly mounted on "R" valve pins, by Mr. Smith; a Mark III set converted to a two-valve set with crystal rectification, in which six different circuits could be used by means of change-over switches, also a short wave tuner, using a Mark III coil as secondary, by Mr. South; a Mark III set converted to valve, using the round 16 circuit, with internal and external coils at will by Mr. Potter; a fine variometer, a loud speaker and a short wave tuner, by Mr. Vincent; an old-fashioned crystal set and still going, also honeycomb coils of various sizes, by Mr. Frazer; a converted Mark IV set, by Mr. Dowlang; a captured German three-valve set, a three-valve set for V 24 valves and a short wave tuner on variometer principle, by Mr. Morley.

There were also many other miscellaneous items, such as coils, condensers, telephones, valves, too numerous to mention.

Mr. McPherson briefly explained the salient points of some of the exhibits, and then the meeting was thrown open for inspection.

Mr. Beeson connected his set to the aerial and amplifier and loud speaker and soon music and telephony from our usual friends came wafting in from the ether.

The exhibitors were soon deluged with enquiries as to how the various pieces of apparatus were made and worked.

At the end of the meeting, which came all too soon, all expressed themselves highly gratified at the success of our first exhibition.

**Southampton and District Wireless Society***.

Hon. Secretary, Mr. T. N. Cutler, 24, Floating Bridge Road, Southampton.

The above Society held its first public demonstration on Wednesday, May 24th, at the Kingsland Assembly Rooms, Southampton, and a very enjoyable and instructive time was spent by the large gathering. The Hall was packed to its utmost, large numbers of people failing to gain admission, and because of the disappointment a further demonstration will be announced shortly.

A variety of instruments were exhibited by the courtesy of Capt. Young, A.I.M.E.E., of Crays Installations. Mr. Smethurst, of Smethurst & Co., electrical engineers, of Southampton, also kindly loaned other apparatus. The Club had their powerful three-valve receiver installed with a three-valve amplifier and loud speaker. Mr. Towsend, of the Marconi Company (a member of the Society) was placed in charge of the Club apparatus and messages were logged by him, communication being established with Paris, Leafield, and various American stations, Barcelona and Gibraltar. Telephony was picked up from Croydon Aerodrome and the concert from **FL** in the early part of the evening. At the conclusion of the demonstration a hearty vote of thanks was accorded the Chairman, Mr. Freeman, and the Secretary, Mr. Cutler, for the able arrangements made. Twelve new members were enrolled.

A meeting was held on May 31st and a fair attendance was recorded. The following business

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was transacted for the evening:—Discussion on various rules for improvement of the Society and the admission to the Society of various firms dealing in wireless apparatus and not at present holding receiving licences. After a lengthy discussion it was decided to call all the members together and hear their views. There were 14 new members' names submitted for membership, but they were not at present holding receiving licences, and as the rule stands they could not be admitted to the Society. This will be brought up at the next meeting. Listening in on the Club set brought the evening to a close at 9.30 p.m.

### Southport Wireless Society.*

The members of the above Society spent a very enjoyable afternoon on Saturday last, when wireless transmission and reception tests were carried out between Parbold Hill and Ashurst Beacon, at both of which places temporary stations were erected. Eleven members, with the Society's portable transmitting sets, took part in experiments which were highly successful. At the conclusion of the tests a very enjoyable tea was partaken of.

It is intended to hold a series of similar outings during the next few weeks.

Hon. Secretary, Mr. R. W. Brown, 71, Norwood Crescent, Southport, to whom all communications should be sent.

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the Club-room at 7.45 p.m. on Friday, June 2nd, with Mr. W. C. Ramshaw in the Chair. At this meeting we were to have had the pleasure of hearing Mr. H. F. Yardley, of Leeds, lecture on "Short Wave Reception," but unfortunately he had to go away on business. However, we hope to have the opportunity of hearing this lecture later on. In the absence of the lecturer, a discussion on members' experiences in connection with wavelengths below 600 metres was opened and taken part in by Messrs. J. Bever, A. Liardet, A. Bever, W. C. Ramshaw and N. Whiteley, each of whom related what experience he had had to date.

The proceedings closed at 9.30 p.m.

### The West London Wireless and Experimental Association.*

Club Rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

A Special General Meeting was held on Thursday, evening, June 1st, a large percentage of the members being present. The purpose of the meeting was to amend the existing rules in regard to subscriptions, and the formation of one or two new rules for the better management of the Association generally. After the business agenda was terminated, Mr. J. F. Bruce and the Vice-President, Mr. F. E. Studt, detailed their experiences with the Reinartz short wave tuner and much useful advice was then given to the members present. Both gentlemen were heartily thanked for their very interesting remarks.

A large party of the members and their friends, by permission of the Air Ministry, paid a visit to the London Terminal Aerodrome and Wireless Station at Croydon on Saturday afternoon, June 3rd, and although the Aero Club races were in progress, the Civil Aviation Traffic Officer on duty gave us a hearty welcome and placed us in the hands of his wireless staff, who were most courteous and entertaining. The whole of the radio station and apparatus was very fully explained to us by Messrs. Lane and Luger, who, in turn, dealt with different items during our visit.

We had a fine view of the races and various flying stunts which were in progress, and had the gratifying experience of watching the arrival of one of the large passenger machines from Paris and unload its complement of passengers and goods, also the giant monoplane from Brussels. We then adjourned to the tea rooms, where the whole of the party sat down to a very enjoyable tea.

The party heartily thanked the gentlemen who had so kindly made our visit so interesting.

The Hon. Secretary will have much pleasure in sending full particulars of the Association to any gentleman who may desire to join us and in view of the great possibilities which undoubtedly are to be met with in the near future.

### Bishop's Stortford and District Amateur Wireless Association.

An *alfresco* meeting was held at Halfacres, Bishop's Stortford, on Tuesday evening, May 30th, to form a local wireless society. A considerable number of interested persons attended. Mr. E. F. Cooper welcomed those present and outlined the objects of the meeting. It was resolved to form a Society under the name of "The Bishop's Stortford and District Wireless Association," and the following were elected:—President, Mr. W. Field; Vice-President, Mr. E. F. Cooper; Secretary, Mr. J. Cooper; Treasurer, Mr. J. Thorpe; Committee, Messrs. Ashford, G. Featherby, W. S. Filby, Lucas, Moore and Rose. At 8 p.m. the company "listened in" to the Marconi Wireless Concert upon the Secretary's installation. Arrangements for meetings, lectures, morse practice, etc., were left in the hands of the Committee. Communications should be addressed to the Hon. Secretary, 2, Half-acres, Bishop's Stortford.

### Stockton-on-Tees and District Amateur Wireless Society.

A meeting was held in the Jubilee Hall, Stockton-on-Tees, on Thursday, June 1st, which was attended by a very large number of interested persons.

It was unanimously agreed that a Society should be at once formed under the above name. The meeting was under the Presidency of S. G. Marston, Esq., Borough Electrical Engineer, who was supported by a large number of interested gentlemen.

It was decided that the Society should be open to any person of any age who was an amateur and wished to take up the study of wireless.

Forty-two members were enrolled and a further large number sent in their names but were prevented from attending, which will make the membership one of the largest in the district.

Mr. J. Mulcaster, of Eaglescliffe, was appointed President, Mr. S. G. Marston as Vice-President, and Mr. W. Wood as Secretary (*pro tem*).

Communications should be addressed to Mr. E. Barnes, Bishop Street, or to Mr. G. Dean, Dovecot Street, both of Stockton-on-Tees.

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**Hounslow and District Wireless Society.***

On Friday and Saturday, May 26th and 27th, we gave a demonstration in receiving at the local Hospital Fete, a good sum being collected for the Hospital. Messrs. S. G. Brown of Acton were kind enough to loan us a microphonic relay and H.I. loud speaker, and a special permit was obtained from the G.P.O. allowing Lieut. H. S. Walker, of Brentford, **2 OM**, to transmit to us music and speech on both days on a wavelength of 440 metres. The demonstration was a huge success, and all members worked very hard. We have been invited to give another show on Messrs. Pears' recreation ground at Isleworth on July 22nd, and another one at Hounslow on July 29th. We will do our best as both are in aid of Hospitals.

On Thursday, June 1st, the Society held its first annual meeting. Various letters were read *re* new publications. The annual report was then read by the Secretary explaining fully the year's working, including several demonstrations, also showing that we have been going forward all the time. Lieut. H. S. Walker then moved the adoption of the report, and in his speech said he hoped to see us expand more than ever, and assuring us he would do his best to help us expand. He further made an offer of a Brown microphonic relay, to the Society on condition that someone else gave a Brown H.I. loud speaker.

Councillor J. J. Bonnet rose and stated it gave him great pleasure to second Lieut. Walker, and commented on the success of the Society in its first year's work, and hoping it would do even better in the forthcoming year. He also thanked Lieut. H. S. Walker for his generous offer, adding that he thought we could call the relay ours.

Later Mr. Gordon Fryer, L.D.S., R.C.S., Eng., headed a list with £2 1s. towards the loud speaker, Councillor J. J. Bonnet added a pound, and other members also contributing made up the required sum. As we are noted for doing things quickly, we shall now have a relay and loud speaker.

The Chairman, Mr. A. R. Pike, in his reply, thanked Lieut. H. S. Walker, Councillor J. J. Bonnet and Mr. Gordon Fryer for their generosity, he also asked for a vote of thanks to be passed to Mr. F. O. Read, as, although Mr. Read was not present, he had given the greatest of assistance in enabling the Society to become firmly established. The vote of thanks was duly passed, and perhaps Mr. Read heard it, for it was certainly loud enough.

The balance-sheet was read and showed receipts for the year, £33 17s., expenditure, £29 0s. 11d., leaving a balance in hand of £4 16s. 1d., showing that the Society always paid its way and had not got into debt. All the existing officers were elected to stand for another twelve months.

If any gentlemen would care to join a real live wireless society, they are asked to move to Hounslow and join us.

Mr. A. J. Rolfe, Hon. Secretary, 20, Standard Road, Hounslow.

**The Ilford and District Radio Society.**

The Society held its first Annual General Meeting on June 1st, the Chair being taken by the President.

The Secretary and the Treasurer in their reports showed that the Society is now in a flourishing condition. In spite of early difficulties with regard to proper headquarters we had eventually secured the use of St. Mary's Church Hall at a reasonable rental and this has proved itself in every way suitable. The Society possesses a considerable amount of apparatus, has both fixed and portable transmitting licences and a very satisfactory financial position, our only trouble being the way attendance falls off as the summer approaches. No doubt other Societies as well suffer this transition from the valve to the racquet.

Mr. J. Scott-Taggart, M.I.R.E., was unanimously re-elected as President for the coming year, but Mr. Vizard intimated that owing to increasing home responsibilities the intense volume of secretarial work was beyond him. Mr. A. E. Gregory was accordingly elected Secretary. Other changes were few, the constitution now being as follows :—

President, Mr. J. Scott-Taggart, Member I.R.E. ; Chairman, Mr. H. Lassman ; Vice-Presidents, Messrs. A. P. Welch, J. E. Nickless, A.M.I.E.E., and L. Vizard ; Secretary, Mr. A. E. Gregory ; Assist. Secretary, Mr. A. G. S. Gwinn ; Treasurer, Mr. F. Grover ; Committee, the foregoing and Messrs. Dewar, A. B. Gregory, Hummerston, Payne and Spence ; Auditors, Messrs. Andrews and Elliott.

The retiring Committee had made several recommendations all of which were adopted. Among them was the reduction of the entrance fee to 5s. and the annual subscription to 7s. 6d., and the formation of a junior section (under 18), with an entrance fee of 2s. 6d. and subscription 5s.

We still have room for new members, and full particulars can be obtained from the Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, E.7.

**Barnsley Amateur Wireless Association.**

An attempt is being made to revive the activities of the above Association, a meeting being held with this object in view, on May 30th, at 7 p.m., in the drapery department of the local Co-operative Society.

The chair was taken by Mr. Cooke, the head manager of the department, and in his opening remarks he spoke of the recent " boom " in wireless, and the demand for a local Association, and he expressed the opinion that the Co-operative Society —which has started a wireless department— would give us their help in ensuring the progress of the Wireless Association.

The Secretary of the Association then gave a brief outline of Wireless, past, present and future, also a short epitome of the history of the Association. He pointed out the need of a suitable room to use as headquarters and as a meeting room, the lack of which had been responsible for the tardiness of resumption of work of the Association.

Marconi's concert was then switched on, signals being rather weaker than was anticipated, probably due to change of wavelength, and afterwards local amateurs working, came through with convincing loudness and clearness.

A sheet for the entry of names of prospective members was tendered and was duly filled in by upwards of two dozen enthusiasts.

An announcement will be made later when a room has been procured. Will persons wishing to become members please communicate with the Hon. Secretary, Mr. G. W. Wigglesworth, 13, King Edwards Gardens, Barnsley, Yorks.

**Wireless Club for Putney and Fulham Districts.**

Mr. Bruce L. Houstoun, of 125, Hurlingham Road, Fulham, S.W., will be pleased to hear from local amateurs with a view to forming a club.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only; Queries should be clear and concise.* (2) *Four questions is the maximum which will be accepted at a time.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"KEPPEL ANAMBA" (Over)** *has a number one unit of single valve long wave set and wishes to increase range from* 3,800 *to* 10,000 *metres.*

You do not say whether the No. 2 reaction winding is wound on the moving former or only the No. 1 winding. If the latter is the case we would advise you to make an entirely separate A.T.I. and reaction for the long wavelengths.

**"C.A.J.B." (Putney)** *has a single valve set working on an indoor aerial and asks* (1) *Why set will not work.* (2) *For suggestions for improvements.* (3) *Diagram to add another valve.* (4) *Wavelength with given tuning coil.*

(1) It is wrongly connected up. There is no connection from negative L.T. to earth. The condenser A is presumably intended to be in parallel with B, in which case the present lead from condenser to negative L.T. and earial should be removed and a connection made from this side of condenser to earth. (2) Connect a 0·001 mfd. fixed condenser across telephones. (3) The additional apparatus required and method of connection will be seen by referring to Fig. 1, page 213, May 13th issue. (4) This inductance is only suitable for wavelengths up to about 600 metres.

**"ECONOFIL" (Herne Hill)** *refers to Fig.* 4, *page* 561, *December* 10*th issue, and asks* (1) *For criticism of circuit.* (2) *If the three circuits containing variable condensers must all be tuned to the same wavelength.* (3) *Best way to arrange circuit for searching.* (4) *The most efficient transformer for crystal circuit.*

(1) The circuit will no doubt give good results if circuits are properly proportioned, and after one has become used to it. The values of capacity which you give should be quite suitable. (2) Yes. (3) A circuit of this type cannot easily be modified for quick searching. It would always be necessary to be tuned beforehand to the wavelength it is desired to receive. (4) The best transformer ratio can only be found by experiment, and as the crystal circuit is untuned it should be at least 2:1. The primary of the transformer should have sufficient winding to tune with variable condenser to wavelengths of other parts of the circuit. The crystal winding should have at least twice the turns of this winding.

**"RADIO" (E.C.3)** *has a three-valve transformer amplifier which is troublesome because of vigorous oscillation which cannot be controlled.*

It is a natural tendency for amplifiers of this type to oscillate freely round about the natural wavelength of the transformers. To limit this it is necessary to make all the internal connections as short and direct as possible, keeping all the leads separate. The principal trouble is through having too large a reaction coil. To obtain a gradual increase of reaction it is necessary to strip turns off and test until the desired result is obtained. A potentiometer control of the first two grids is necessary.

**"LANE" (Edinburgh)** *asks* (1) *Dimensions of former for A.T.I. to take* 1 *lb. of No.* 28 *DCC.* (2) *Maximum and minimum wavelengths on small aerial.* (3) *Will certain condenser do for crystal set.* (4) *What stations will be heard.*

(1) For a crystal set No. 28 wire is too fine. Use No. 24 and wind a 5" diameter × 10" former full of it. (2) The diagram shows condenser across A.T.I., but for crystal set it should be in series. The wavelength range will then be from 2,800 metres at maximum down to about 400 metres minimum. (3) This may be used. Its capacity is 0·0005 mfds. (4) The number of stations that will be heard is very limited. You will hear ship and coast stations, and possibly the Eiffel Tower.

**"BEGINNER" (Bournemouth)** *asks questions regarding a single valve set.*

You will not find the circuit shown in your diagram very effective. We suggest you rearrange it as shown in reply to **"BELLRINGER" (Walsall).** With suitably proportioned inductances you should be able to hear both Eiffel Tower and Chelmsford telephony.

**"STICKER" (Earley)** *asks for windings for* 300/3,000 *metres for reactance formers as advertised.* (2) *Suitable circuit to use.* (3) *How to add amplifier to long and short wave set.*

(1) Formers of this type are not very efficient for such a wide wavelength range. As experimental windings we suggest you wind the A.T.I. former full of No. 28 and the reaction full of No. 36. (2) This might be incorporated similar to that given to **"BELLRINGER" (Walsall).** (3) Several diagrams have recently been given showing how to add a L.F. valve to existing single valve set.

**"C.W.B." (Kent)** *asks* (1) *Capacity of two condensers.* (2) *Wavelength of certain inductances with above condensers.* (3) *If reaction coils given are suitable for use with inductances in No.* 2. (4) *What effect would lengthening the aerial have on above calculations.*

(1) Capacities are (A) 0·0003 mfds; (B) 0·0005 mfds. The minimum capacity cannot be calculated.

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(2) Wavelength of 15½" × 5½" former with condenser A is 7,000 metres; with 9" × 3½" former with condenser B 4,200 metres. (3) There is quite enough reaction winding for both formers and it may be necessary to take a few turns off when using the set. The wavelength will be approximately proportional to the length of the former given in your example. (4) This would slightly increase the wavelength values.

"**SHOLOMPOTS,**" **(Cardiff)** *asks* (1) *For diagram of simplest single valve circuit to use crystal set A.T.I.* (2) *Suitable size for reaction coil.* (3) *Maximum wavelength range.* (4) *If possible to hear* **2MT** *concert.*

(1) The best arrangement for a single valve set is given to "**D.R.**" **(Doncaster).** (2) This may be 8" × 4" of No. 28. (3) The diagram referred to shows a 0·0005 mfd. aerial condenser. If this

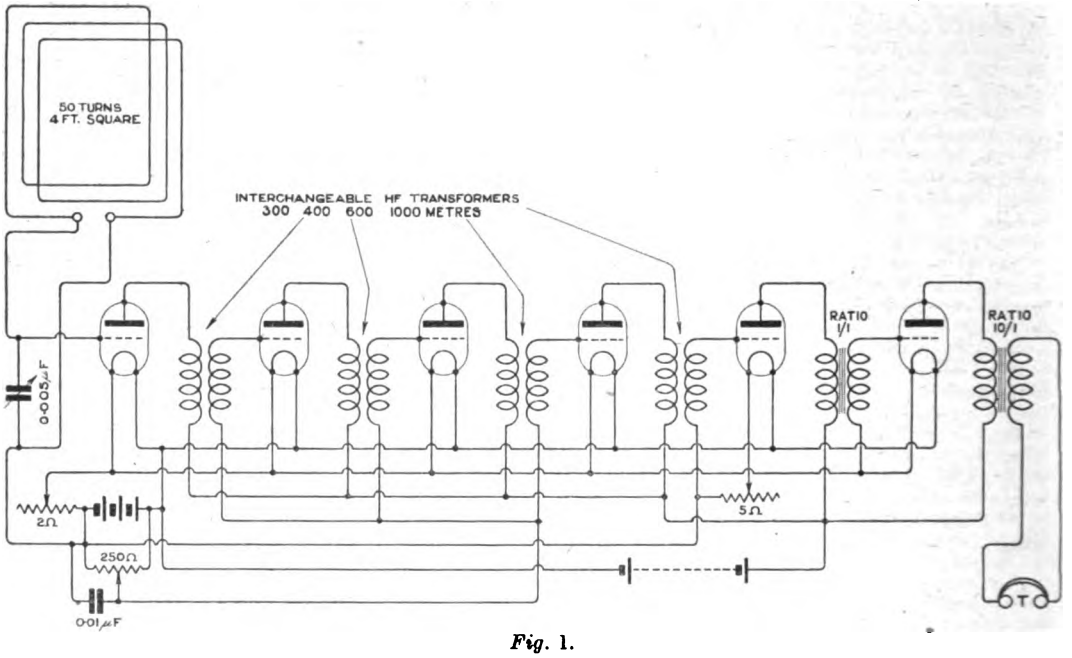


*Fig.* 1.

is used the maximum wavelength with inductance given will be 2,700 metres, with switch in series position, and 5,000 metres in parallel. (4) If the set is carefully adjusted you might just hear it, but an additional L.F. valve is advisable.

"**RADIOBUG**" **(Kilburn)** *refers to Fig.* 3, *page* 90, *April* 15*th issue, and asks* (1) *For windings for* 120/10,000 *metres, to use two complete sets of tuning coils.* (2) *If capacities given in reply to* "**H.R.H.**" **(Bristol),** *the same issue, are suitable.* (3) *Connection of switching arrangement to introduce crystal detector.* (4) *How many tappings to closed circuit reaction coils.*

(1) For efficient short wave reception make first set wavelength up to 1,000 metres and second up to 10,000. For short wave set make coils as follows:—A.T.I., 4" × 4", No. 22; coupling coil, 2" × 2", No. 22; secondary, 3" × 3", No. 22; reaction, 2" × 3", No. 28. For long wave set:—A.T.I. 6" × 10", No. 28; coupling coil, 3" × 4", No. 28; secondary, 6" × 10", No. 34; reaction, 5" × 10", No. 28. (2) These values may be used except that of the A.T.C. which should be 0·001 mfd. (3) As this would necessitate tuning the anode circuit by means of a variable condenser we do not recommend its use. The grid condenser and leak will give very efficient rectification. (4) There might be three tappings on each of the closed circuit and reaction coils.

"**F.H.**" **(Dorset)** *wishes to install a telephone receiving set with loud speaker in a large room.*

If set is mainly intended for reception of Dutch concert there is no object in going to the trouble of making it a complicated set for 300/20,000 metres. It is advisable to use an outdoor aerial, but if desired a 5′ or 6′ square frame may be used. To get satisfactory results from Holland on a frame aerial, six valves will be required, or with an outside aerial four valves. A diagram showing how to arrange set and giving as much information as space allows is given in diagram (Fig. 1).

"**ROOKIE**" **(Woodside)** *asks* (1) *For windings for tuning coils and L.F. transformers for a set consisting of crystal detector and one L.F. magnifying valve.* (2) *Capacity of condenser for secondary circuit.* (3) *Resistance of telephones to use with transformer recommended.* (4) *If capable of receiving Dutch concerts.*

(1) For a maximum wave range of 3,000 metres the following coils will be required:—A.T.I., 5" × 10", No. 26; coupling coil, 3" × 3", No. 26; secondary, 4" × 8", No. 26. The transformer No. 3 should be wound on a soft iron core ½" diameter 2½" long, and should have its primary winding 1 oz. of No. 44 connected to the crystal circuit, and the secondary 3 ozs. No. 44 in the grid circuit of the valve. The transformer 4 should be 3 ozs. of No. 44 and 6 ozs. of No. 32, wound on a similar core to No.

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3. **The grid winding of No. 3 should be connected** directly to the negative side of filament. No advantage is gained with this circuit, using a grid potentiometer. (2) This should be 0·0005 mfds. variable. (3) Telephones should be 120 ohm connected to the thick wire winding of the transformer. (4) It is very doubtful if it will be received on this set. A valve circuit with reaction coil is really necessary. It will be quite suitable for the English broadcasting stations.

"**S.O.S.**" **(Swansea)** *asks* (1) *The best length for spreaders of twin wire aerial.* (2) *Are there any advantages or disadvantages due to the aerial being placed on rising ground.* (3) *How to make grid condenser with lead pencil lined leak.*

(1) A very convenient length is 5′. (2) The diagram given does not convey much information regarding the contour of the land. If there is a considerable rise, which takes the ground level above the highest point of the aerial, there may be a certain amount of screening. (3) The grid condenser might be made of two pieces of copper foil, 2″ × ¾″, separated by a thin sheet of mica. It is not possible to give accurate dimensions for such a leak. One can be made by rubbing lead pencil on about a 2″ length of slate pencil, until best results are obtained. This is a very crude arrangement, and far more satisfaction would be gained if one is bought.

"**J.F.F.**" **(East Grinstead)** *cannot obtain results on a three-valve resistance capacity amplifier. It appears that the short wave telephony is not received with the two or three valve set because insufficient H.T. voltage is used.*

"R" valves, anode volts 40 to 60, should be used with 80 to 100 volts when in a resistance capacity amplifier. This allows for voltage drop across the external resistance. If this additional voltage does not improve matters it will be necessary to substitute H.F. transformers for the resistances and condensers. The transformers should be connected in the circuit as shown in Fig. 5, page 62, April 8th issue. It will be necessary to have separate transformers for 400, 1,000 and 3,000 metres, to receive Writtle and the broadcasting stations, the Dutch concerts and Eiffel Tower. When connecting the two-valve amplifier in circuit in place of the single valve, it is necessary to change over the reaction coil connections as the current flow in the circuit is reversed.

"**NOVICE**" **(Swinton).**—The additional telegraph wires should not increase the interference with your set.

"**J.L.**" **(Brighouse)** (1) *Refers to additional apparatus in a cabinet set.* (2) *If a spark coil may be used for the H.T. supply in a transmitting circuit.*

(1) If the set gives good results at present we see no object in adding either a crystal or H.F. valve. A crystal will be no better than the rectifying valve already in use, and an additional H.F. valve would take up about 5″ square, which space is probably not available on the existing panel. (2) If the H.T. voltage were passed through a rectifying valve into a smoothing condenser the arrangement might be made suitable for a lower power set.

"**EARLY BIRD**" **(Reading)** *asks for winding for reaction former for 300/1,200 metres.* (2) *Size of grid condenser.* (3) *Is there a Wireless Club in Reading.* (4) *Best circuit for telephony for above former.*

(1) **No mention is made of winding space available,** but trial windings might be outer former wound full of No. 26 inner former full of No. 28. (2) Two copper foils, 2″ × ¾″, separated by a thin sheet of mica. (3) The Reading Radio Research Society, Hon. Secretary, Dr. L. L. Phillips, 73, London Street, Reading. (4) Single-valve circuit given to "**D.R.**" **(Doncaster),** will be found most suitable.

"**VALVE**" **(Hull)** *has a two-circuit crystal receiver which he desires to convert to a valve set.*

If valve were added as shown in diagram (Fig. 2), the existing rectifier could be used as desired. This, however, would not be suitable for C.W., for the reception of which the set would have to be made into a single-valve reaction set similar to the one given to "**D.R.**" **(Doncaster).** This circuit would be more useful to you than the diagram given above.

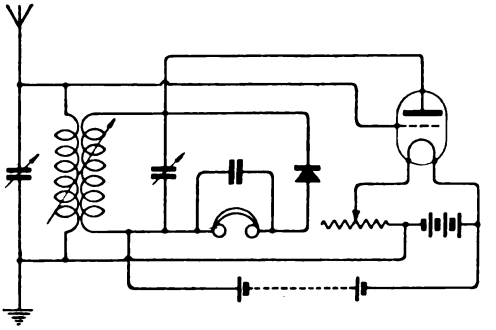

*Fig.* 2.

"**C.F.L.**" **(Bingley)** *gives a transmitter diagram which is incorrect and asks for constructional details.*

The single-valve transmitter, given on page 185, May 6th issue, will probably be more suitable than the one you have shown. In this circuit no choke coil is required. The condenser across the H.T. might be about 0·002 mfds. The microphone transformer should have about 10,000 turns for the grid winding, and about 200 each for the microphone and buzzer windings. Condenser across grid winding of transformer 0·001 mfd., and across the 1,000 ohm resistance 0·002 mfd. A.T.I., and reaction coil windings cannot be given without some knowledge of the wavelengths to be transmitted and size of aerial.

"**NOVICE**" **(Cornwall).**—We think it will be satisfactory to install the receiver on the third floor provided a good stout earth lead is used. See also the Instructional Articles on Experimental Station Design.

**L.W. (Fulham)** *asks* (1) *For advice as to position of an aerial.* (2) *What aerial wire to use.* (3) *Type of coil.* (4) *What earth connection is best for protection from lightning.*

(1) The position you indicate for the aerial should be satisfactory, but it would be better, if possible, to avoid running any part of the aerial so near the house roof. (2) 7/22 stranded phosphor bronze is probably the best, but any copper or phosphor bronze single strand would do if not less than No. 18. It is not at all essential that the aerial wire should be enamelled. (3) There is little to choose between the different types of coils you mention. (4) The earth should be satisfactory, remembering that when earthed as a protection against lightning,

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all leads to earth from the aerial should be external to the house.

"**TRIODE**" **(Bishop's Stortford).**—(1) *Does the length of P.M.G. aerial include the leads inside the house.* (2) *If aerial and earth leads inside the house of* 20 *yards each will effect reception.* (3) *In this case should the earth lead be insulated.* (4) *If aerial sketched is satisfactory.*

(1) Presumably yes, as it includes the down lead to the instruments. (2) Probably the effect would be serious; if this arrangement is unavoidable the aerial lead should be kept right away from walls, etc. (3) Yes, preferably. (4) Yes.

"**W.B.B.**" **(Ashbourne)** *asks for advice regarding a single-valve French set.*

Without a diagram of connections of your set or some further details it is impossible to advise you.

"**H.D.**" **(Hornsey)** *asks* (1) *The gauge of samples of wire enclosed.* (2) *If single layer coils could be used in place of pile wound coils for the single valve long range receiver described in earlier issues.*

(1) All three samples are No. 30 gauge. White is S.C.C., green D.S.C., and brown S.S.C. (2) We would not recommend you to attempt this as the set was designed for this particular method of winding, giving very tight coupling.

"**P.L.**" **(Teignmouth)** *asks* (1) *How to identify various stated systems of transmission.* (2) *The order of the stations when calls are made.*

(1) Tonic train and chopped C.W. are the same system of transmission, a clear high note is produced in the telephones audible *with* and *without* reaction. For arc reception the receiver must be oscillating as for all C.W. reception. The sound in the telephones is not so crisp as in the case of ordinary C.W., and it is usually possible to hear the steadily emitted signalling wave corresponding to the carrier wave in telephony. It is easy to identify an arc station if it is heard starting up before signalling is commenced. High speed service may be spark or C.W. In the telephones a continuously emitted signal is heard composed of signals made at rapidly succeeding intervals. The sound resembles the rattle of the discharge from an induction coil, but is, of course, a very small sound in comparison. Quenched spark is sometimes difficult to distinguish from some other methods of spark transmission. The Telefunken quenched spark has a high-pitched note, which is easily identified from familiarity with it.

"**N.B.**" **(Broughty Ferry)** *has a coil* $4\frac{1}{4}'' \times 5''$ *wound with about* $2\frac{1}{2}$ *ozs. of No.* 18 *and wishes to use this as a primary inductance. Asks* (1) *For dimensions for a secondary winding range,* 300-1,500 *m.* (2) *Wire for secondary.* (3) *Capacity of condenser across it.* (4) *For a two-valve diagram using a particular circuit.*

(1), (2) and (3) On a former $3\frac{1}{2}''$ diameter, wind $2''$ of No. 32, using a variable condenser of 0·0015. (4) See Fig. 3, but it should be remembered that resistance-capacity coupling is not suitable for amplification below about 1,000 metres.

"**ANXIOUS**" **(Hexham)** *asks for detailed instructions for the construction of an efficient set.*

See the three-valve set described in the issues of April 1st and 6th, 1922.

"**G.P.T.**" **(Coventry)** *asks* (1) *If upstairs or downstairs is the best location for apparatus.* (2) *What use can be made of No.* 38 *enamelled copper wire.* (3) *Can* **2MT** *be received in Coventry with a crystal detector only.* (4) *Certain questions re the formula* $\lambda = 1885\sqrt{CL}$.

(1) The instruments should be located downstairs as the earth lead should be as short as possible. (2) Might be used for secondary of telephone transformers—enamelled wire is not recommended for H.F. intervalve transformers. (3) Very unlikely. (4) In the formula quoted the self-capacity of the inductance L is included in the value assigned to the capacity C. If the self capacity of the inductance is ignored it will always be found that the calculated wavelength will be less than the actual wavelength to which the circuit will tune in practice.

"**S.H.**" **(Leytonstone)** *gives a single valve circuit and asks why the Marconi concerts are scarcely audible.*

Your circuit shows no grid leak. Try the circuit with a leak of 2 megohms connected from the grid side of the grid condenser to the negative end of the filament. You will probably require more than 50 volts H.T. with an "R" valve. We cannot say who is the station transmitting on the wavelength you mention.

"**L.W.**" **(Bournemouth).**—With such an aerial you will not get much with a crystal. As you do not give the length or number of wires of your aerial it is not possible to estimate to what wavelength you can tune, but probably you will not get above 6,000 or 7,000 metres with the tuning coil you describe. No battery is necessary with a zincite bornite combination crystal. Possibly the plates of your variable condenser are making contact somewhere. A variable condenser is not necessary where you show it in your circuit; instead, put it in place of the battery in your diagram.

"**R.C.**" **(Godalming)** *asks why set sketched will not oscillate on or below* 1,000 *metres. How to add two additional valves to his existing three-valve set.*

Your circuit is not good as it stands. The reason for non-oscillation is probably due to the absence of a shunt condenser across your H.T. battery, which at present acts as an impedance in the oscillating circuit. For a five-valve circuit try that on page 680 of the February 4th issue, inserting

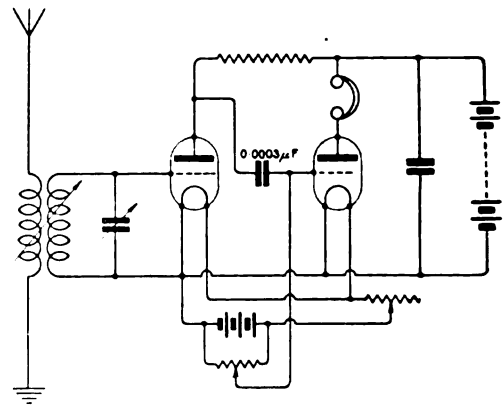


*Fig.* 3.

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the reaction coil in the plate circuit of the third valve.

**"S.W.J." (Hendon)** *asks for a circuit for a three-valve set, one H.F., one detector and one L.F. valve, and for advice in winding a tapped H.F. transformer in a slotted former.*

For a circuit see page 15 of the issue for April 1st 1922. As you do not state wavelengths required, it is quite impossible to suggest windings for the transformer. See an article on page 588 of the November 13th, 1920, issue for useful help.

**"A.J.R." (Cardiff)** *asks* (1) *If several basket coils can be used in series for a tuning inductance.* (2) *If mean diameter of basket coils is 2¾" how many turns of No. 26 are required for 5,000 metres with a 0·0005 variable in parallel.*

(1) Yes, but for the lower wavelengths it is better to wind single layer on a former. If several basket coils are used in series they should be spaced about ¼". (2) Up to 1,500 m. wind on a former 3½" in diameter 3½" of No. 26 D.C.C.

**"ROVER" (Hammersmith).**—Your circuit is quite wrong. See p. 119 of issue for April 22nd for a two-valve circuit. Your secondary would tune to about 1,400 metres, with a 0·0001 mfd. variable condenser, or to about 4,000 metres with a 0·001 mfd.; the wavelength to which the primary will tune depends upon the valve of your aerial.

**"RADIO" (Alum Rock).**—You do not give the diameter of your coils, and therefore we cannot calculate the wavelength. Eight tappings should suffice for the cloud circuit inductance, but they should be graded and a variable condenser connected across the inductance for tuning.

**"H.T." (Scunthorpe).**—The closed circuit should be arranged as in Fig. 3, page 90, of April 15th, 1922, issue, the value of the grid leak being 2 megohms and the grid condenser about 0·0002 mfd.

**"GILJO" (Brickhill)** *asks* (1) *How to proceed to get wavelength below 600 m. when his smallest coil will not oscillate below that.* (2) *Who transmitted a "C Q" concert on Friday, April 28th.* (3) *If grid leak and condenser are necessary with added stages of amplification.* (4) *For criticism of circuit sketched.*

(1) You probably will have to reduce the size of your aerial. (2) See account under "Notes" column of the issue for May 13th. (3) The function of the grid leak and condenser is to rectify the incoming oscillations and this or some other method of rectification must be used, and should be employed after H.F. and before L.F. amplification. (4) Your circuit is quite wrong. See instead the circuit given on page 15 of the April 1st issue.

**"R.H." (Barnsley).**—(1) *Sends a picture of a variometer former he has purchased and suggests that the slots are insufficiently deep for reaction and aerial tuning inductances.* (2) *Asks if 40 D.C.C. is suitable for the windings.* (3) *Asks if a condenser in parallel with A.T.I. increases wavelength and in series reduces it.*

(1) The former is more suitable for use as a variometer, particularly for short wave tuning—for circuits see article in *The Wireless World and Radio Review*, page 281, of June 3rd issue, by F. Rumford. The inside former is sufficient for reaction coil, and the outside is sufficient for coupling with additional inductance in series for longer wavelengths. (2) No. 40 is too fine a gauge for A.T.I. or reaction coil; use No. 22-26. (3) Yes

**"MIRAMARE" (Bristol)** *sends a sketch of his circuit asking what is necessary in order to be able to tune down to 180 metres and lower.*

Your circuit being resistance capacity coupled is unsuitable for amplification below about 800 or 900 metres. Use H.F. and transformer coupling for the H.P. valve, connect your grid leak from the grid of the second valve, and use a variable condenser in series with your A.T.I. and earth to reduce wavelength, or reduce the size or number of wires of your aerial.

**"E.G.K.T." (Bradfield)** *has used circuits Figs. 10 and 12, p. 726 of issue for Feb. 18, and asks for advice.* (2) *For a good two-valve circuit for Writtle and Croydon telephony.* (3) *What is wrong with a valve which emits blue light.* (4) *If he would be better advised to use H.F. transformer instead of resistance capacity coupling.*

(1) Fig. 10 should show a condenser shunting the telephones and H.T. battery. It is difficult to say what is the cause of the peculiar results you have been getting. (2) The circuit Fig. 1, page 119, of the issue for April 22nd, should be suitable, and a further valve for H.F. amplification might be added if you wish to increase strength. (3) Obviously your valve is "soft"; too much H.T. or too bright a filament will sometimes aggravate this trouble, but it is generally the valve which is responsible owing to it being insufficiently exhausted in the process of manufacture. (4) Yes, transformer coupling is better for short waves and resistance capacity for 1,000 metres and above.

**"J.G." (Westminster)** *asks for the wavelength range of a number of slab coils and gives only the number of turns of wire in each.*

In order to calculate these values it is necessary for you to tell us the gauge of wire, whether D.C.C., D.S.C., etc., and all external dimensions of the coils.

**P.C.G.G. (Sunderland)** *sends a sketch of the connections of his set and asks various questions.*

Your set might tune up to about 3,000 metres, but as you do not give any particulars of your aerial it is not possible to give you an accurate estimate. The purpose of the 0·0002 condenser is not apparent from your sketch, it would be better connected between your terminals 6 and 8. You might get FL but not PCGG with this single valve set. A variable condenser, say 0·0002 across your terminals 3 and 4, would probably improve your results.

**"H.E.J." (Rugby)** *asks* (1) *If a Mullard "Ora" valve can be used in the set described in issues of February 5th and 19th, and March 19th, 1921.* (2) *If the use of this valve would mean any difference in the construction of the set.* (3) *Amount of wire required in the construction of this set.* (4) *For values of coils and condenser.*

(1) and (2) Yes, without alteration of set (3), 2½ ozs. of No. 26 and 1½ of No. 32.

**"R.B.F." (Spondon)** *asks* (1) *Where four-electrode valves as described in the 1921 Year Book can be obtained and what price.* (2) *Gives a circuit employing a four-electrode valve for telephony transmission and asks if it will work.* (3) *If it is better than that given on page 671 of the January 21st issue.*

(1) Marconi Scientific Instrument Company. Price about 45s. (2) Your circuit should work, but see issue of 29th May for a better arrangement.

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Also see issue of May 13th for information on these valves. (3) Probably yes, but it is a matter for experiment. (4) Without knowing your desired wavelengths or your aerial dimensions it is not possible to help you. 0·001 mfds. would be suitable for the condenser.

"**J.H.P.**" **(Mansfield)** *asks for a valve and crystal circuit for the Marconi concerts.*

Use the circuit given in Fig. 1, page 90, of issue for April 15th. To use valve alone include a switch to short circuit the crystal and crystal battery and potentiometer.

"**NEW READER**" **(Liverpool)** *sends a sketch of a crystal circuit and asks various questions.*

You should connect to the mid-point of your battery and not to the end of the potentiometer, otherwise the circuit is correct. You are unlikely to get any results worth while with an indoor attic aerial and crystal set, and with low resistance telephones you would probably get nothing. The annual licence fee for a receiving set is 10s. Apply to the Secretary, G.P.O.

"**J.T.B.**" **(Stockport).**—For satisfactory reception of **PCGG** not less than two valves are recommended. You should get **2MT** well with one. A three-valve amplifier is described in the issues of April 1st and 8th. Very full constructional details for a tuner having the range you require appeared on page 344 of the issue for September 3rd, 1921. There is little to choose between the single wire or twin wire aerials of the dimensions you give —use whichever is most suited to your location. It is better to use low resistance telephones with a telephone transformer. The price of these together is about the same as for high resistance telephones.

"**A.W.F.**" **(Seedley)** *asks* (1) *and* (2) *For circuit diagram and details for construction of the tuning coils of the B.T.H. portable set.* (3) *If this set would work with a single wire aerial instead of the frame, and* (4) *if it would receive the* **2MT** *transmissions with a small frame aerial.*

(1) and (2) We cannot give data for the construction of marketed sets. (3) Yes. (4) Possibly, but certainly would with an external aerial.

"**NIMROD**" **(W.1)** *sends sample of wire (No.* 26 *enamelled) and asks* (1) *What wavelength he can read with an A.T.I.* 12″ × 5½″, *wound with this wire, and a* 0·001 *across it.* (2) *Dimensions for a reaction coil.* (3) *Diagram for a suitable valve circuit using slider A.T.I.*

(1) You do not give details of your aerial, but with a two-wire P.M.G. aerial you would reach about 4,500 metres. (2). If you use the same gauge of wire you will require about 5″ on a 4″ diameter former, and the winding might preferably be tapped. (3) See Fig. 4, herewith; this circuit would be suitable for reception of telephony.

"**E.C.S.**" **(Manchester)** *asks if we recommend for general use of amateur the single valve set described in Vol. VIII, and if the set will receive telephony.*

Experience has shown that amateurs find great difficulty in carrying out the pile winding required in the construction of this set and the efficiency of the set depends entirely on how this is done. The set will receive telephony, but we would recommend a set with a more limited range of wavelengths or interchangeable coils.

"**FRAME AERIAL**" **(Leicester)** *asks* (1) *If he could use the frame aerial described in the April 17th, 1920, issue, with a crystal receiver and valve note magnifier in place of the four-valve amplifier.* (2) *What difference would this make to the range of the set.* (3) *Would he receive* **2MT** *and* **PCGG.** (4) *Would* 750 *ohms telephones do.* (5) *How to change four-figure time into ordinary time.*

(1) A crystal set followed by valve magnification would be useless with a frame aerial. (2) and (3) You might possibly get very loud stations in your immediate neighbourhood — you would certainly not hear **2MT** and far less **PCGG.** (4) A telephone transformer would be necessary with these telephones. (5) To read four-figure time take the first two figures to denote the hour and the last two to denote the minutes. If the first two figures are less than 12 the time is before noon, and if the first two figures are more than 12 the time is after noon and 12 should be deducted from the number to arrive at ordinary time. Thus, 0230 is 2.30 a.m., 1430 is 2.30 p.m., 1730 is 5.30 p.m.

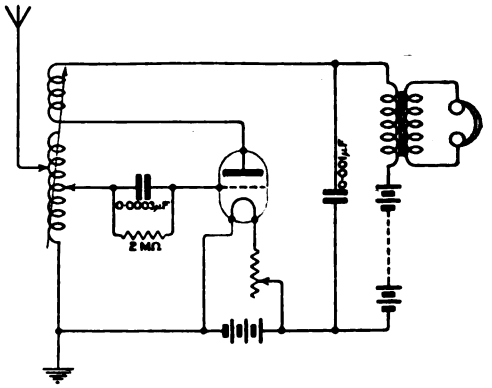


*Fig.* 4.

"**A.I.**" **(St. Leonards)** *sends a sketch of a crystal circuit and asks* (1) *If circuit is correct.* (2) *If he will get decent results on a fifty-foot aerial.* (3) *If a drain pipe will make a good earth.* (4) *What range has a loose coupler with primary* 5½″ × 5″ *wound with* 30 D.C.C., *and secondary* 6″ × 4½″ *wound with* 32 D.C.C.

(1) Yes. (2) You must not expect to get much with this aerial and a crystal set—you will get ship stations and some of the high power European spark stations. (3) The drain pipe will make a fairly good earth if it is all metal and goes underground with a short path from your instruments to earth. Some metal drain pipes empty into non-metallic pipes without making good contact with earth at any point. (4) With a 0·0002 condenser your secondary will tune to about 2,000 metres. The range of your aerial tuning coil it is not possible to estimate accurately without more particulars of your aerial, but probably it will tune to about 2,000 metres too.

"**ABSOLUTELY**" **(Edmonton)** *asks* (1) *For a circuit to show how to add one stage of L.F. amplification to a detector valve circuit.* (2) *For a suitable L.F. transformer for this set.* (3) *Would it receive* **PCGG.**

(1) See Fig. 1, p. 119, of issue for April 22nd. (2) See pp. 152-155 of issue for May 28th, 1921. (3) Possibly with skilful handling.

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**"SMALL HEATHER" (Birmingham)** *asks questions regarding a crystal set of which he sends a circuit diagram.*

Your circuit is correct except for the inclusion of a battery in series with your telephone blocking condenser. This is quite wrong, no battery is required here but might be used with a potentiometer in conjunction with your crystal. For Method of connecting up see Fig. 2, p. 120, of April 22nd issue. We cannot give you the value of the capacity of your variable condenser without knowing the spacing of the plates and the dielectric. As you say there are five fixed and four moving vanes you can arrive at the capacity as follows: Multiply the area of one plate measured in square centimetres by 0·00000707, and divide the result by the spacing between the plates measuerd in millimetres. This will give you the approximate capacity of your condenser in microfarads. With your coil and a 0·001 condenser in parallel you would tune to about 15,000 metres or more but it is not possible to estimate accurately without knowing the dimensions and number of wires of your aerial. You could not get 2 MT with a crystal set in Birmingham

**"H.A.E." (Farnham)** *asks* (1) (*a*) *For wavelength to which a coil* 4" × 12" *wound with No.* 28 *W.G. enamelled and shunted with a* 0·0006 *will tune.* (*b*) *A similar coil wound with* 36. (*c*) *Both coils in series and shunted with a* 0·0006 *condenser.* (2) *How many foils* 1" *square are necessary for a condenser of* 0·001 *mfds., using mica as sample submitted.* (3) *What is the filament consumption of an ordinary "R" valve.*

(1) (*a*) About 7,000 metres. (*b*) About 11,000 metres. (*c*) About 13,000 metres. (2) Six foils. (3) 0·5 to 0·6 amp.

**"H.G.O.B." (Irthlingboro)** *asks* (1) *For a book on winding inductances and reaction coils in single layer windings.* (2) *If a certain type of resistance is suitable for the H.T. battery for a single valve set.* (3) *The respective merits of different types of coil windings.* (4) *For windings and number of tappings for reaction coil to work with certain coils he possesses.*

(1) We do not know of any book which treats thoroughly of single layer coils alone. The Radio Experimenter's Handbook, by P. R. Coursey, just published, gives very full data for coils of all types including, of course, single layer. (2) The modern hard valve does not require a fine adjustment of the H.T. potential, it is quite sufficient to be able to vary the voltage in steps of one or two cells at a time. (3) Where space permits it is preferable to use single layer coils for inductances owing to their low self capacity and the fine tuning which can be obtained as a consequence. When other types of windings are used those having the least self capacity are to be preferred. Where basket coils are required to be used for long wavelengths it is best to use several reasonably sized coils spaced say one inch apart and connected in series. (4) Wind say 5" of No. 26 or 4½" of No. 28 on the 3½" former, and take off three tappings. The former for the reaction coil should be independent of the secondary former in order that their relative positions may be varied.

**"T.W.H.J." (Acton).**—We have no information regarding proposals for broadcasting from Northolt station. The most complete list of wireless stations in this country and amateur stations is contained in the 1922 edition of The Year Book of Wireless Telegraphy. Any of the types of coils you mention would be equally suitable for your single valve set, provided the values were suitable for the wavelengths you wish to receive. You should be able to bring the wavelength down to the value you mention with the small condenser in series.

**"A.C." (Golders Green)** *asks* (1) *If a twin aerial of* 50 *feet is better than a single wire of* 75 *feet.* (2) *Is there a maximum wavelength for a cheap crystal receiver.* (3) *If batteries are necessary with crystal receivers.* (4) *If* 8,000 *ohms telephones are better than* 2,000 *ohms with a crystal set.*

(1) Yes. (2) By adding inductance you would be able to reach any desired wavelength, but your set may be designed only up to a certain wavelength, as it stands. (3) Some crystals, such as carborundum, work better with a small potential controlled with a potentiometer. You would then require two dry cells arranged as in Fig. 5, page 124, of the April 22nd issue, where a potentiometer and battery is shown in use with a crystal. (4) Yes. A satisfactory crystal receiver should be obtainable at the price you mention but we cannot advise you without knowing the set.

**"C. de G." (Smethwick)** *wishes to convert a crystal set to a single valve set and asks* (1) *If the diagram Fig.* 8, *page* 778, *of the issue for March* 4*th*, 1922, *would do.* (2) *If a telephone transformer is necessary.* (3) *What batteries to use.* (4) *What valve.*

(1) Yes. (2) With your telephones a transformer would not be necessary, the two earpieces together give a resistance value of 4,000 ohms. (3) Your 4-volt accumulator will serve for the filament, and you will require not less than 45 volts for the plate voltage. If your flash lamp batteries are the ordinary type containing three cells the total voltage is 4½ volts. The number you mention is therefore sufficient. (4) The "R" type valve would be satisfactory.

**"MOORHASETT" (Melton Constable).**—The method of mounting coils appears to be satisfactory provided that the spring clip makes good contact. We do not know the composition of "Kenidgoid" and cannot therefore advise you as to its insulating properties. There would be no object in using a variable condenser as you suggest. To satisfy yourself you might enquire of the company concerned. We cannot undertake to give advice on patent questions.

**"RELAY B." (Lewisham)** *asks for advice re the erection of a station.*

A single valve set is described on pages 140 to 141 of the issue for April 29th, 1922, and the details given there should be enough to guide you. An external aerial such as you describe would give better results. The microphone transmitter would be satisfactory for the purpose.

**"B.H.R." (Harpenden).**—You could not get the Hague concerts with a crystal receiver. It is extremely difficult with one valve but has been accomplished successfully.

**"T.W.J." (Huddersfield)** *asks* (1) *Where to apply for an agate cylinder for the Johnsen and Rahbek apparatus described in a recent issue.* (2) *For the address of the author of this article.* (3) *If a Brown microphone amplifier could be used instead of the microphone described*

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(1) We believe these can be ordered through Messrs. James Gregory, of 139, Fulham Road, London, S.W.6. (2) Correspondence addressed, c/o The Editor, will be delivered. (3) No doubt this could be used but an ordinary microphone gives all the results that can be desired.

**"C.D.P." (Monmouth)** *asks questions regarding the erection of an aerial and if the stay wire of a telegraph pole in parallel with the aerial will interfere with reception.*

The stay will not interfere much with your reception if at all, but its effect will be less if your aerial crosses it at an angle as you suggest.

**"H.W.J." (Chester)** *sends a circuit diagram of a four-valve set and asks why he does not get good results.*

First of all your grid condenser and grid leak should be in the grid circuit of the second valve, not the first, which is intended for H.F. amplification in your particular circuit. You might dispense with the tuned circuit in the plate circuit of your first valve. The values of your grid leak and condenser are not suitable, try 2 megohms and 0·0003. The wavelengths over which you can receive will depend upon the windings of your H.F. transformer. The condenser across your H.T. battery might be 0·002, not 4 microfarads as you show it.

**"PROTON" (Acton)** *asks* (1) *Which of two circuits sketched is better for* **2 MT** *telephony.* (2) *If it matters seriously having his instruments located a considerable height above the ground for receiving.* (3) *Where a description of electrostatic telephones may be found.* (4) *If the inductances of aerial circuit, closed circuit and reaction coil should be equal or in any particular ratio.*

(1) Your sketch, Fig. 2, would be more satisfactory, the grid condenser and leak being 0·0003 and 2 megohms respectively. (2) Not very much for reception. Your lead to earth should be as direct as possible. (3) Many text books describe the electrostatic telephone. See Eccles' "Handbook of Wireless Telegraphy and Telephony," page 284-5. (4) The inductance of the closed circuit should usually be a considerably higher value than the inductance of the aerial circuit coil, since the latter has added to it the inductance of the aerial and the capacity of the aerial to bring up the wavelength to the required value. The value of the inductance of the reaction coil is independent of wavelength.

**"GALENA" (Stockholm).** (1) *If it is possible to get amplification of signals on a crystal set without the use of valves.* (2) *Is perikon more stable in use than galena.* (3) *The filament and plate voltage required for "telefunken" valves and if they are suitable for detecting and amplifying.*

(1) Not without strong signals and the employment of a sensitive relay. (2) There is not much to choose from the point of view of stability. (3) We do not know to which particular type of valve you refer, but if they are war-pattern valves, 4 volts filament and 60-80 volts plate, should be satisfactory. They are usually good detecting valves and would serve well for amplification also.

**"SILICON" (Goodmayes)** *asks various questions regarding a crystal set and for a circuit diagram of the "Tf" three valve set.*

You would not receive **2 MT** with a crystal set at your distance. A combination of zincite and bornite forms a very sensitive detector. A brass wire point is suitable for use with silicon We are unacquainted with the "Tf" set.

**"D. McC." (Edinburgh)** *asks for names and particulars of stations transmitting weather reports* (1) *For North Sea.* (2) *Irish coast and North Atlantic.*

Norddeich sends a meteorological forecast for the North Sea daily at 1015 G.M.T. on 600 metres spark, the call signal being **KAV**, and again at 2130. As you are a regular reader we refer you to the supplement issued with January 7th, 1922, number, where particulars of most of the meteorological transmissions of Europe are included. We do not know of any radiotelephone transmissions from coast stations in Europe.

**"H.I.P." (Cardiff)** *is troubled with interference from electric trams passing near by and asks* (1) *How to avoid the interference.* (2) *What alterations to make to set an aerial.*

(1) It is hardly likely that you will be able to overcome this trouble but (2) if you are willing to make the sacrifice in signal strength you would probably avoid much of the interference by dispensing with L.F. amplification.

**"1914 READER" (Halifax)** *sends a circuit diagram of a three-valve set with tuned anode circuits and asks* (1) *If the wiring is correct.* (2) *If it is possible to arrange for the inductance of the tuned anode circuits and their tuning condensers to be common to both circuits to avoid separate tuning.* (3) *How to avoid noises.* (4) *If "R" valves are unsuitable.*

(1) The circuit appears to be correct but the inclusion of a variable condenser across the reaction coil is an unnecessary additional tuning complication. (2) No. (3) Some of your trouble may be due to howling of the set, especially if it occurs most on short wavelengths. Try using a potentiometer to control the potential of the grids in a manner similar to that shown in Fig. 2, page 682 of issue for February 4th, modifying to suit your circuit. (4) "R" type valves should be quite suitable.

## SHARE MARKET REPORT.

Prices as we go to press on June 9th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 10 | 9 |
| ,, Preference .. .. | 2 | 6 | 10 |
| ,, Inter. Marine .. .. | 1 | 13 | 0 |
| ,, Canadian .. .. | | 11 | 2 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 2 | 4 |
| Preference .. .. .. | | 14 | 9 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 13. JUNE 24TH, 1922 WEEKLY

## The Production of Beats at Audio-Frequency

### SOME SUGGESTIONS FOR EXPERIMENTS

APART from the ordinary application of the principle of heterodyning to the reception of wireless signals many other applications of heterodyning are possible and some of these provide a wide and fascinating field for experiment.

In making use of this principle for the reception of undamped waves we generate locally in the receiving circuit a frequency differing slightly from the frequency to which the incoming signals are tuned. The effect then is that we get a resultant frequency audible in the telephones.

If we call the frequency to which the incoming signals are tuned $n_1$, and $n_2$ the frequency generated locally, then $n_1 - n_2$ (or $n_2 - n_1$) will give us the frequency of the note in the telephones.

In the reception of undamped waves by this means we may employ either *autodyne* or *heterodyne* circuits. In the case of autodyne reception the locally generated oscillations are obtained from the same triode as is used for detection in the same circuit, whereas by the separate heterodyne method the local oscillations are generated in an independent circuit, inductively coupled to the receiver circuit.

A circuit arranged for beat reception of undamped waves in the method described above, employing the same triode for the generation of local oscillations as for detecting is shown in Fig. 1. Here the circuits A and B are tuned, the one to the fre-

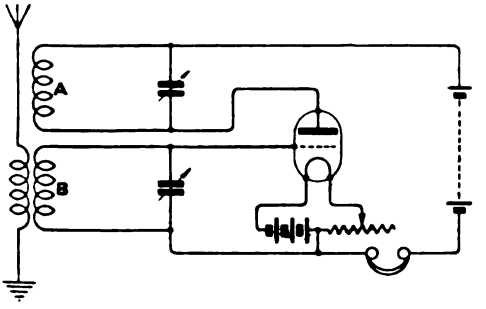


*Fig* 1.
*Autodyne circuit for Beat reception.*

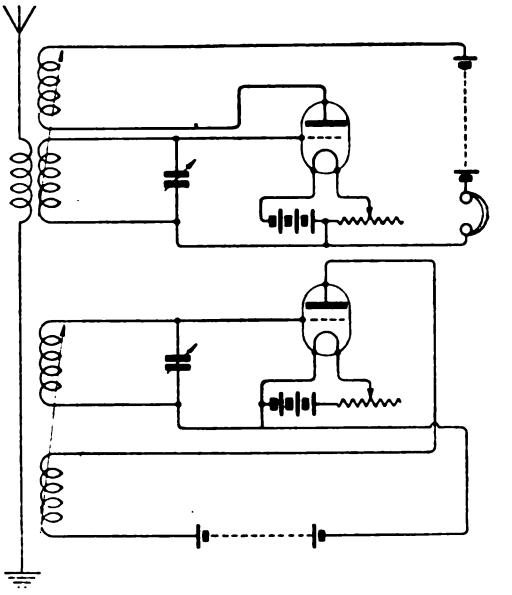

*Fig. 2.*
*Circuit using seperate oscillation for Beat reception.*

quency of the incoming signals and the other to a slightly different frequency of such a value that the resultant beat note will be of an audible frequency in the telephones.

Where an external heterodyne is employed with an independent triode for the purpose of generating the local oscillations, the circuit may be arranged as in Fig. 2, where again two circuits are tuned

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to slightly differing frequencies to bring about the same production of beats of audible frequency in the telephones.

The frequencies generated in the circuits A and B Fig. 1 and in the circuits of Fig. 2, are obviously controlled by the values of the capacity and inductance of the circuits, and if one or other of the circuits is kept constant, and a change is made either in the value of the inductance or capacity of the other, the resultant beat note heard in the telephones will change its frequency.

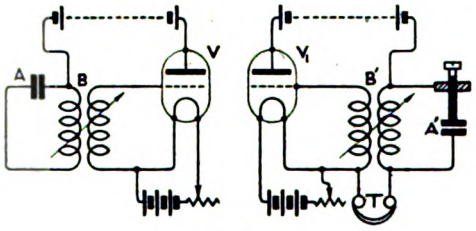


*Fig. 3.*

*Circuit used for physical measurements.*

In practical work it is very much more convenient to control the frequency of the circuits by a variation of the value of the capacity rather than of the inductance, and this is done by means of a variable condenser.

The effect produced by the change of capacity of this condenser has formed the basis of experiments conducted by Professor R. Whiddington in the measurement of extremely small physical quantities.* In his experiments Professor Whiddington employed a circuit arrangement as shown in Fig. 3, where A′ was a condenser, the spacing of whose plates could be conveniently controlled.

When in this case the right-hand circuit had, say, a frequency of one million, if the left-hand circuit were caused to oscillate at a frequency of 995,000, then a resultant beat note of a frequency of 5,000 was obtained in the telephones, so that a comparatively small change in either of the circuits produced a very much greater proportionate change

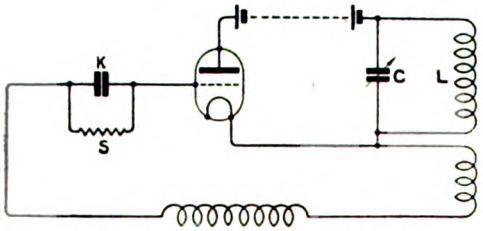


*Fig. 4.*

*A circuit where K is the varying capacity.*

in the resultant beat note. The nearer the two oscillatory circuits are brought to the same frequency the more pronounced becomes the change in beat frequency produced by a small change in frequency of either circuit.

In practical working a difficulty is experienced here since it is found that when the two circuits are so closely tuned there is a stong tendency for the one to drag the other into step and, of course, the moment this happens, the production of beats ceases. This trouble may be largely overcome by loosening as far as possible the coupling between the circuits, but here again, by so doing, the strength of the beat note may be so far weakened as to render it inaudible in the telephones.

In order to overcome these difficulties, a third circuit may be arranged having a very large capacity and inductance to produce oscillations of an audible frequency close to that produced by the resultant beats of the two main circuits. In this manner loud slow beats can be obtained between the two oscillations of audible frequency. With such an arrangement, Professor Whiddington found it possible to detect a movement of the plates of the condenser A′ of as small a value as 1/200,000,000th of an inch.

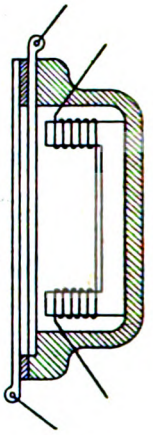

*Fig. 5.*

In a paper read before the Institution of Electrical Engineers†, Dr. W. H. Eccles and Miss W. A. Leyshon, B.Sc., have described other circuits

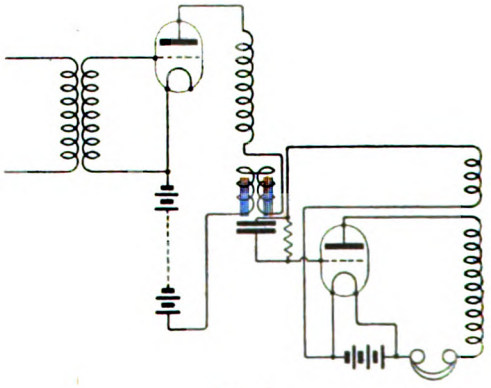

*Fig. 6.*

*Circuit for electro-magnetic control of capacity.*

making use of the principle of the change in resultant beat note of two oscillatory circuits which can be brought about by a minute change in the capacity of one of the circuits, and they have suggested the application of the principle as forming the basis for relays actuated by extremely feeble currents or by extremely small movements of conductors. A

* Wireless Valve Circuits as Applied to the Measurement of Physical Quantities. By R. Whiddington, M.A., D.Sc., a paper read before the Wireless Society of London, December 21st, 1920.

† Some Thermionic Tube Circuits for Relaying and Measuring. March 16th, 1921.

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circuit suggested is that of Fig. 4, where K is the condenser of small capacity the variation of which is to be detected, N is a large inductance, C and L are the inductance and capacity of the oscillatory circuit and S is a grid leak.

The change in the capacity of the small condenser may be brought about either by varying the spacing of the plates or by the movement of an independent conductor in the electric field produced by these by the incoming signals of say, a wireless receiving circuit. The electro-magnet may be the electro-magnet of an ordinary telephone receiver, the diaphragm of which forms one plate of the condenser and the other is formed from a metal plate, parallel and in close proximity to the diaphragm. Such an arrangement is shown in Fig. 5. Further circuits, where the changes in the capacity of the condenser are controlled electro-

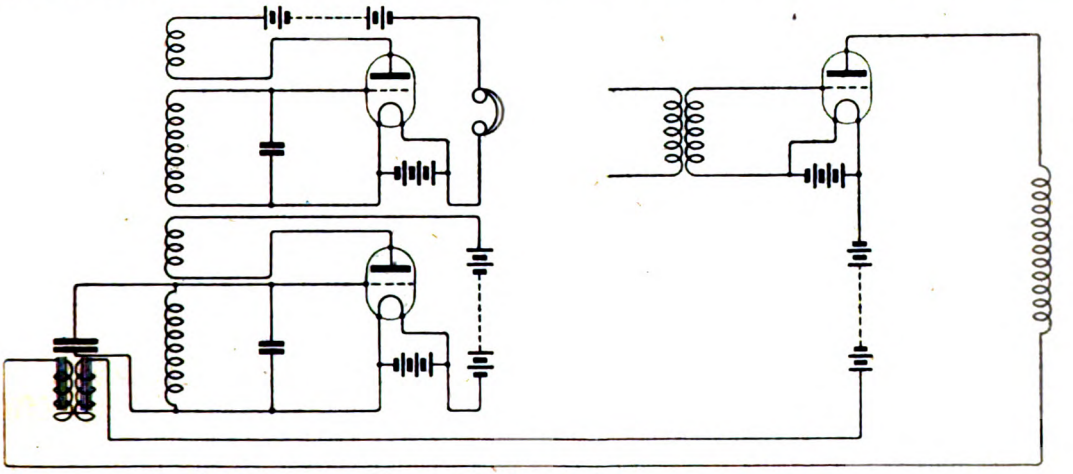

*Fig. 7.*

*The application of the arrangement to a practical receiving circuit.*

plates. The conductor between the plates might consist of the pointer of a galvanometer, the sting of an Einthoven galvanometer or the leaf of a gold-leaf electroscope.

In order that the condenser shall have a large capacity it is desirable that the plates should be as close together as possible and the surface area should not be too small.

In Patent No. 159,377, Dr. J. Robinson and H. L. Crowther describe an application of this effect where one plate of the condenser whose variation affects the beat frequency is caused to move by means of an electro-magnet which is itself controlled magnetically are given in Figs. 6 and 7. In Fig. 6, the value of the grid condenser is varied and hence the frequency of discharge determines the pitch of the note heard in the telephones.

In experimenting with any of these circuits it should be borne in mind that, in general, in order that the changes in frequency produced should be as great as possible, the distributed capacity of the circuit in which the condenser to be varied is included, should be kept as low as possible, and hence the inductances should be wound so as to have the least possible self-capacity.

H. S. P.

# A Five-Electrode Valve*

By J. P. PRANGNELL.

IN this paper it is my endeavour to briefly describe the experiments carried out with the above-mentioned valve.

We are all acquainted with the 3-electrode valve and have heard in all probability something about the one containing four electrodes, but it is my privilege to introduce to your notice a valve of my own invention having five electrodes, consisting, as you will observe, of one filament, two grids and two plates (see Figs. 1 and 2). As I have only just received the valve from the manufacturers, it will be readily understood that I have by no means completed my experiments. I have done sufficient, however, to justify my stating that it will do wonders in the way of magnification.

I will first of all show you in Fig. 3 one of the circuits I have tried, with great success. It will be observed that an ordinary "R" valve is used as a rectifier. Grid 2 is coupled through the transformer $Tr_1$ to

* A Paper read before The Dartford and District Wireless Society.

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*Fig.* 1.

the plate of the rectifying valve and remains at a steady negative potential all the time. The "R" valve is not then called upon to rectify, but as soon as the latter is affected by an incoming signal, Grid 2 becomes more or less positive. Transformer $Tr_2$ is adjusted by the potentiometer in such a manner as to be just on the point of oscillating at audio-frequency. When a signal, for example a dash, is detected by the "R" valve, it causes variations of potential in the primary winding of the transformer $Tr_1$ which are passed on to the secondary winding and cause Grid 2 to become more or less positive, allowing a greater flow of electrons to pass from the filament to the Plate 1.

The increase of electrons is sufficient to cause the transformer $Tr_2$ to oscillate for the period of the dash and then return to its normal potential.

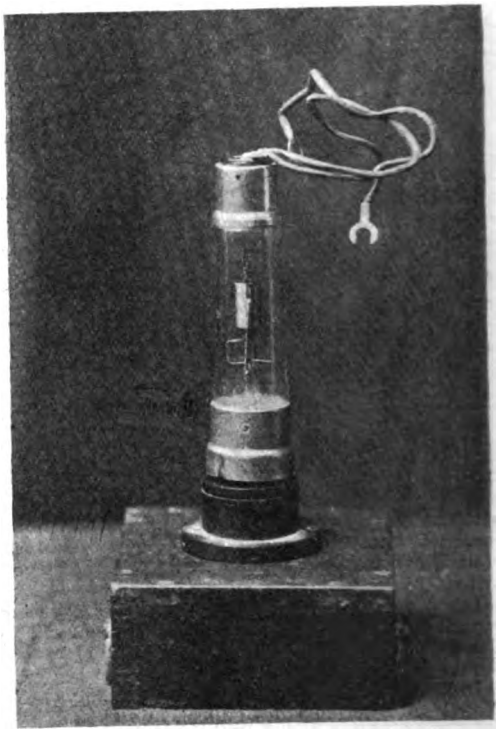

*Fig.* 3.

The oscillations which take place in the transformer circuit $T_2$ cause a varying potential between Plate 2 and the filament. These variations of potential are heard in the telephones in the form of a gruff note similar to that of a spark station. A signal which is just audible with one valve can be sufficiently amplified, when this circuit is employed, to be heard 20 feet from the telephones.

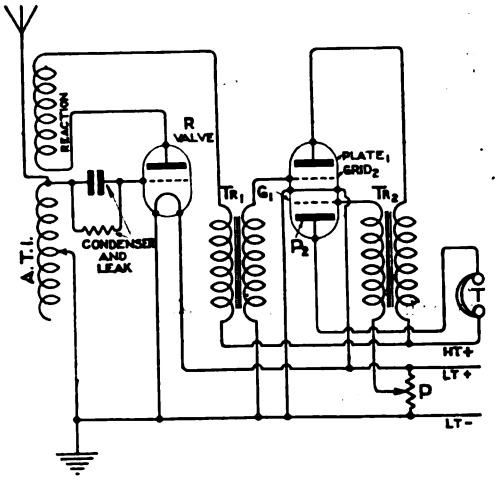


*Fig.* 2.

*A circuit for use of the five-electrode valve.*

## Questions and Answers.

In our next issue an important announcement regarding our Questions and Answers columns will appear.

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# A Dynamic Model Illustrating the Action of Tuned Electrical Circuits.*

AN interesting demonstration of a dynamic model of tuned electrical circuits was given before the Institution of Electrical Engineers on Wednesday, June 7th, by Professor C. F. Jenkin, C.B.E., M.A., M.I.E.E.

The author suggested that the use of dynamical models to represent electrical circuits often makes the behaviour of such circuits easier to understand or, at any rate, easier to visualise. When he began to play with wireless circuits he found it difficult to realise the effects of each part of the complex circuit made up of the aerial and the tuning inductance and capacity, and, in particular, the effect of changing the coupling of the inductance and the capacity from series to parallel; he had therefore attempted to make a dynamical model to represent the circuit. The model as finally arranged illustrated many of the fundamental properties of oscillating circuits in a striking manner.

Proceeding, Professor Jenkin explained that the essential thing in a dynamical model is that the mathematical equations for the motions of the various parts should be the same as those for the electrical circuit, and it is further desirable that the model should have some similarity of appearance to the electrical circuit so that its motion may be accepted by the mind as analogous to the behaviour of the electric circuit.

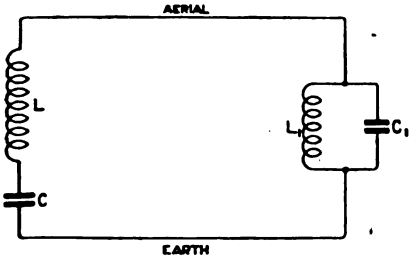


*Fig.* 1.

*The electrical circuit represented by the model.*

To make the mathematical equations the same it is well known that inductances may be represented by masses, capacities by springs, and resistances by friction (assumed to be proportional to velocity).

The electrical circuit is shown in Fig. 1, where the aerial is represented conventionally as an inductance in series with a capacity to earth.

The dynamic model is shown in Fig. 2. The inductances are represented by masses; the capacities by cantilever steel springs; the electric circuit by a *circuit* of string. The inductances may be varied by increasing or decreasing the masses, while the capacities may be varied by increasing or decreasing the length of the springs; these latter are fixed between wedges which may be put in at any point in their length. Quantities of electricity (coulombs) are represented by lengths of string; currents, by velocity of string; voltages, by forces. Thus the voltage across a condenser is represented by the difference of the tension of the string above and below the spring, and the charge by the deflection of the spring.

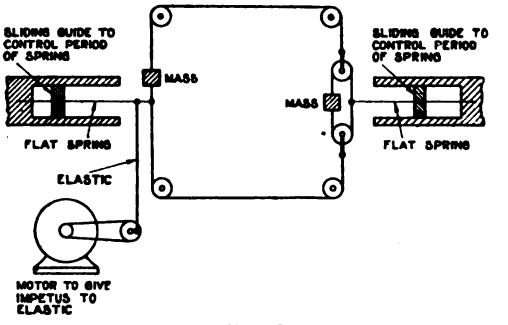


*Fig.* 2.

*Diagram of the dynamic model.*

When the tuning condenser and reactance are connected in parallel, the corresponding mass and spring are connected side by side. When, on the other hand, the tuning condenser and reactance are connected in series, the mass and spring are connected in series (but a simpler change, having the same effect, is produced by inserting a wedge jamming one of the floating pulleys).

The behaviour of the model may be most easily followed by beginning with some simple examples.

Telephone engineers are familiar with the use of inductances and capacities in parallel for separating direct or low-frequency currents from high-frequency currents. Let the tuning capacity and inductance be connected in parallel as in Fig. 1, and then:—

(i) Apply a very low-frequency E.M.F. by moving the left-hand spring slowly up and down. The whole current will in this case flow through the coil; the right-hand spring does not deflect.

(ii) Apply a high frequency. In this case the whole current flows through the condenser; the right-hand mass is almost still.

(iii) Slowly reduce the frequency until the resonating periodicity is reached. Violent motion of mass and spring then results with hardly perceptible motion of the string representing aerial, *i.e.*, no current can flow in the aerial since a tuned circuit blocks the way. This experiment illustrates

* Abstract of a paper given with a demonstration before the Institution of Electrical Engineers on Wednesday, June 7th, 1922.

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the use of a tuned inductance for coupling two valves usually termed tuned anode coupling; there is a high potential difference (string tension) across the combination.

Next consider the whole model. A few trials show that it has a natural period which it will maintain, the amplitude being reduced gradually by friction.

The natural period may be found from the equation:—

$$p^2 \left\{ \frac{L'}{K'} + \frac{L}{K'} + \frac{L'}{K} \right\} - LL'p^4 - \frac{1}{KK'} = 0,$$

where

$L$, $L'$ are inductances or masses.

$K$, $K'$ are capacities or deflections of springs per unit force.

$p = 2\pi \sim = 2\pi/T$. $T$ = periodic time.

This is a quadratic in $p^2$; there are therefore two natural periods. After making a few trials we hit the second natural period. With the one natural periodicity the springs move up and down together; with the second natural periodicity the springs move in opposite ways.

Let the pulley next be wedged so that the mass is now attached to the spring, that is, the inductance and capacity are in series. Again there is a natural period of vibration, which may be timed and compared with the former two. In this case both masses and both springs have the same motion and the period is the same as that calculated for a single spring with stiffness equal to the sum of the stiffnesses of the two and a mass equal to the sum of the two masses (or a single condenser of elastance equal to the sum of the elastances of the two and a single inductance equal to the sum of the two inductances).

To represent a Post Office aerial, the aerial spring must be made very short and its mass small. To tune the circuit to large wavelengths a large loading mass is required; the natural period then becomes practically independent of the aerial capacity and inductance.

# Some Effects of Capacity on Mutual Induction

By J. H. REEVES, M.B.E.

(*Continued from page* 350).

## DISCUSSION.

### The President.

I feel sure that most of us present have experienced some of the effects that have been mentioned to-night, although very few of us may have taken the trouble to analyse the cause of them. I have had the same experience with something I have been doing during the last few days, not with tuning inductances, but with intervalve transformers. In last week's *Wireless World and Radio Review* there was a short article about negative reaction. By coupling a small coil in the grid circuit of the first valve with the intervalve transformer you got rid of howling effects. I have tried it and it certainly is good and does no harm to the long waves at all; but with short waves it alters the calibration of the wavelengths somewhat. It is a nuisance from that point of view. I used two valves, and coupling my small coil to my high frequency transformers I moved it about in exactly the same way as Mr. Reeves and the effects were identical. You could place it where it improved the signals, place it where it made no effect and you could rest it between the two transformers and find the best position. As regards the effect on short and long waves everybody who has tried it must have noticed it, as it is very marked indeed with this arrangement, that is to say, that for long waves it generally effects an improvement. Another point is the capacity effect obtained by shielding two transformers. I used a metallic shield and the effect very greatly improved the signals in every case. It corresponded with the capacity effect described by the lecturer.

I think that is all I have to remark on the experiments and I will now ask gentlemen to discuss the subject. Perhaps Mr. Coursey would open the discussion.

### Mr. P. R. Coursey.

Mr. Reeves has described to us this evening experiments in wireless reception that he has carried out with a view to reducing interference. The question of reducing interference is always one that is very close to the heart of every experimenter, and this fact makes the paper have a special interest.

He raised a point about the definition of inductive coupling and of mutual inductance. I should very much like to have specific instances, if he can quote us one or more, in any well-known textbook, of the definitions to which he referred. I was fortunate enough in having the opportunity of perusing Mr. Reeves's paper some little time ago, and since then I have looked up this question. In the textbooks to which I have referred it seems to be very clearly stated in most of them that mutual inductance refers to magnetic linkage only, being defined in terms of the common magnetic flux lines linking with both circuits.

Most of them—take Eccles' Handbook for instance—give this type of definition. I admit there *are* loose definitions, but I have not seen any quite on the lines of those he has referred to, and I would like some specific instance.

I take it, therefore, that in the title of his Paper, where he uses the term "mutual inductance," he understands a definition of the type he mentioned, and not the usually accepted meaning of the term. If the usual meaning is taken the title, of course, would require some modification.

In reading the Paper, the author referred to the formulæ for coupling and the absence of expressions for other forms than magnetic coupling. There is, I believe, a general formula for any type of coupling between circuits. I would just like to write it on the

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board because I think it might be helpful. One symbol $k$ is used for the general coupling coefficient and it may be written as :

$$k = X/\sqrt{X_1 X_2} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $X$ is the common coupling reactance of whatever nature it may be, magnetic or electrostatic; and $X_1$ and $X_2$ are the corresponding reactances in the primary and secondary circuits. If we substitute in that general expression the appropriate quantities for magnetic coupling, viz., $M$ for the mutual inductance between the two circuits, $L_1$ for the inductance of the primary, and $L_2$ for the inductance of the secondary, we get the usual formula for magnetic coupling, viz.,

$$k = M\omega/\sqrt{L_1\omega . L_2\omega}$$
$$= M/\sqrt{L_1 L_2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In the case of electrostatic coupling where $C$ is the coupling capacity, the common static coupling reactance is $1/C\omega$ and if we divide that by the respective reactances, $1/C_1\omega$ and $1/C_2\omega$, the whole thing simplifies into $k = \sqrt{C_1 C_2}/C \quad . \quad . \quad . \quad . \quad (3)$

I have not seen this method extended at all but it would seem to me that it ought to be possible to extend that general equation (1) to include the mixed coupling which Mr. Reeves has been describing to-night. The type of circuit which he has been using can be represented electrically by his Fig. —. Whether he has one or two coupling capacities, their effective value can be represented by a capacity $C$; while the mutual inductance which he also has between his circuits can be represented by $M$. Hence, the coupling reactance in this formula (1) can be represented by $(M\omega \pm 1/C\omega)$, the plus or the minus sign being taken depending upon whether the two couplings assist or oppose one another. As regards the corresponding reactances of the two circuits, I would suggest that as the two circuits—the primary and the secondary—are each tuned to the signal frequency, they will behave practically as non-inductive resistances for frequencies close to the values to which they are tuned—in a similar manner to the well-known rejector circuits. Hence the form of the general expression (1) above will, in this case, become somewhat as follows :—

$$k = \frac{M\omega \pm 1/C\omega}{\sqrt{R_1 R_2}} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Hence we see that in this case the coupling coefficient is no longer independent of the frequency since the numerator has two terms involving the frequency $(\omega/2\pi)$ while over a small range of frequencies the denominator is independent of the frequency. Obviously if one coupling opposes the other there is a position where the numerator is zero, and it would seem to me that this is the case which Mr. Reeves has been describing. In other words we not only now have the tuning qualities of both circuits but our coupling itself is a function of the frequency and therefore we have increased selectivity, since $k$ becomes zero for a particular adjustment and frequency and has a definite value for frequencies higher or lower than the one required to give this "silent point."

Of course, I am open to correction, and am merely putting this forward as a suggestion. I hope someone will tell us some more about it to-night.

From this point of view of increased selectivity what we get by the form of mixed coupling that has been described is a means of discriminating between two frequencies which are very close to one another, and to which, to all intents and purposes, the two circuits are tuned. Obviously if the e.m.f's. due to the two couplings are exactly opposite in phase, so as to get a silent point (and we cannot get a silent point unless they are), that numerator in equation (4) will be zero for one frequency only, and shows that there will be some effective coupling from one circuit to the other for all other frequencies. Whether or not this is the explanation, the results that have been described are very interesting.

I am afraid I somewhat fail to see the reason for drawing so much distinction between the so-called "static couplers "and the similar circuit with a variable condenser electrostatic coupling. The two circuits are similar to a type often used with purely electrostatic coupling between the two, but it seems to me that Mr. Reeves's couplers are nothing more than two condensers in series. Apart from the fact that they are two condensers with a relatively bad dielectric, I cannot see that there is a difference, provided the effective capacities are made the same in each case. If there is a difference actually in operation it would be extremely interesting to have the reason for it elucidated.

In connection with his fine wire coils, I believe the idea of resistance in one or more of the tuning circuits for reducing interference has been tried before, and to that extent there is little new in it. What one is doing is to wipe out the effect of the resistance by retroaction with the valve for one particular frequency only.

The author of the paper referred to the good results he has obtained in wiping out atmospherics. I should like to ask him if he has heard any during the last few days, because I have heard quite a lot (laughter), as, if his apparatus has been completely successful during this period, it should be well worth further study. (Applause.)

**Mr. G. G. Blake.**

First of all I would like to congratulate Mr. Reeves on the work which he has put into his investigations. I would like to ask Mr. Reeves whether he finds that with these combined magnetic and capacity reactance connections, there is a decided diminution in signal strength ? Or does he find them as loud as when using ordinary magnetic reactance coupling ? I have made up a tuner of the Reinartz type, working on the lines suggested by Mr. Harris in his article in *The Wireless World and Radio Review* of May 13th. (This tuner makes use of combined magnetic and capacity coupling.) I find that its selectivity is splendid, it almost entirely eliminates jamming, also the atmospheric troubles are reduced to a very remarkable extent and I may instance my experience this morning when I heard both interference and atmospherics on a set using ordinary electromagnetic reactance, but avoided both these troubles with the Reinartz set.

I find the tuner excellent for all comparatively strong signals and telephony, but it is practically useless for the reception of weak strength amateur transmissions. I would like to have Mr. Reeves's views on this point.

(Mr. Blake then showed the set, Fig. 7, which



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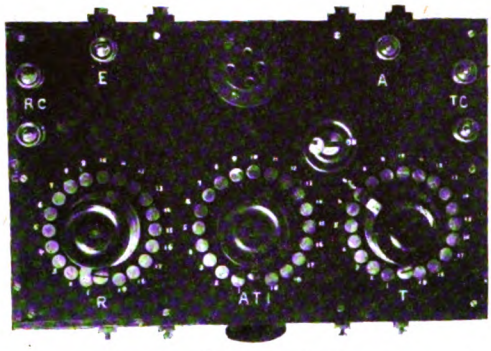


*Fig. 7. The Reinartz Tuner.*

he had made and an X-ray photograph, Fig. 8, showing its interior construction, together with a blackboard diagram reproduced in Fig. 9.)

I may also point out the necessity of the telephones being left in circuit to act as an impedance when the set is connected by terminals X and Y to the input transformer of a note magnifier.

Ordinarily, terminals X and Y are shorted by a strip of metal.

R = Reaction coil (magnetic component), 38 turns, with 19 tappings.

A = A.T.I. coil, 19 turns with 19 tappings one at each turn.

$L_1L$ = The grid inductance, 110 turns, the first tapping at the 20th turn and then tapping at every 5 turns.

S = A switch which when set on its off position breaks the grid inductance after the 7th tapping to remove dead end effects when receiving short waves.

C and $C_1$ = Two variable condensers having a capacity of 0·0005 mfd. The set receives below 150 metres and up to 1,100. The maximum wavelength on tapping 7 of grid inductance is 500 metres.

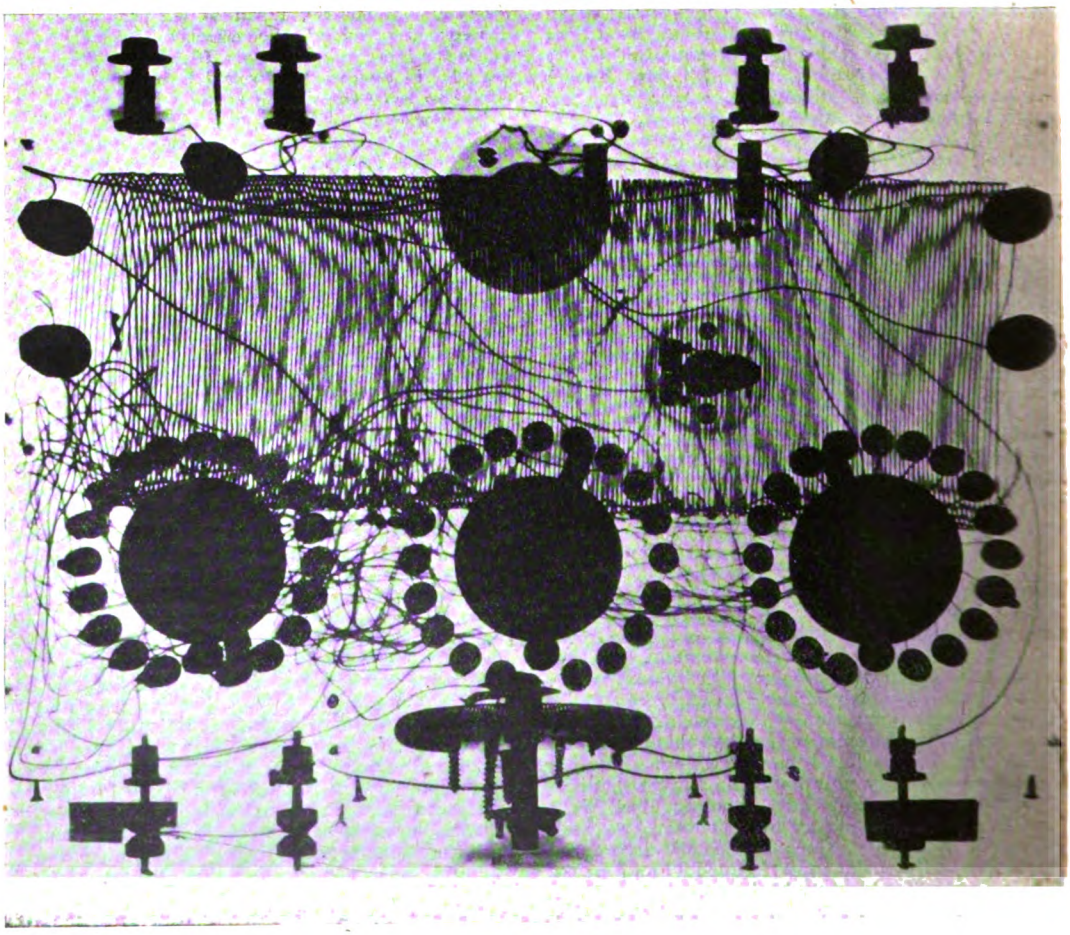

*Fig. 8. X-Ray photograph of Mr. Blake's Reinartz Tuner.*

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Condenser C' can be omitted and a small fixed condenser such as those employed for a grid condenser inserted in its place. All reactance adjustments are then made by varying the magnetic component R.

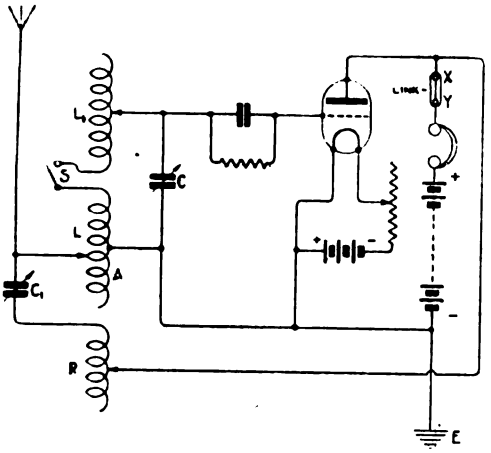


*Fig. 9. Circuit diagram of the Tuner.*

*Fig. 9. The inductances and reactance are wound on one former, 3" in diameter and of No. 22 gauge cotton-covered wire afterwards shellaced and baked.*

## Mr. R. E. H. Carpenter.

Mr. Reeves has asked where he can find expressions for capacitative and magnetic coupling. I think he will find them if he will look in circular No. 74 of the Bureau of Standards, which he can get from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A., for the small sum of 60 cents. plus postage. It is one of the most valuable books on radio telegraphy of which I know. He will find expressions such as those Mr. Coursey has so ably developed for electric and magnetic coupling. Further, he asked where he could find some methods of determining the increase of resistance due to self-capacity of the coil. I think he will find that lucidly treated also in the same book.

With regard to Mr. Coursey's remarks I think he has thrown a flood of light on the method of operation of this interesting device which Mr. Reeves has described to-night. It occurs to me as possible in connection with the formula $k = \frac{M\omega \pm 1/C\omega}{\sqrt{R_1 R_2}}$ which he developed, that there might conceivably be a differential effect between signals of different strength so that if the valve grid circuit is in parallel with the sort of circuit described it is conceivable that there will be a different result according to the amplitude of the oscillations. It seems possible that for C.W. signals, at any rate, there will be some differential effect due to the value of $R_2$ varying with the grid damping and therefore with the amplitude of the signal. What it will do is to cut out an unwanted station of different intensity. (Applause).

## Mr. M. Child.

As many of our members here have dealt with some of the most important points of Mr. Reeves's paper, I think that I have only to say that I am extremely interested in Mr. Reeves's experiments. I have followed his work very closely from time to time, and I can confirm in every way the results which he has obtained. There is no doubt that, providing the bridging clips are properly set up the apparatus is extremely selective in the way in which he has described it to us. I am personally a little sceptical as to whether this method of obtaining highly selective tuning is of practical value, that is to say, I do not see quite how you can complete a practical instrument using the coils that he is using here to-night, which will give us the reaction which is necessary. It is very easy to get these results with coils separated and set out on the table, and I have noticed in all his experiments that he has always taken care to have them spaced, but when we come to make a practical instrument utilising the principles that he has outlined to-night, it is rather a difficult matter, I think, using these static couplers round the coil. I quite think that, providing a suitably fine condenser is arranged across the coils, we ought to get these results. I think, as a matter of fact, Mr. Reeves developed these static coils from an idea I had mentioned. I think he will remember a conversation we had when I mentioned putting a condenser across the coils in that way and these strips were the outcome of further work and mainly on account of the fact that the condensers which we had at the time were much too large in capacity. The actual capacity of these strips there must be of the order of something like 0·000005 microfarads. Using a small condenser, it is quite a practical thing to work. There is one little point that perhaps Mr. Reeves can give us further information about. Mr. Blake raised the question just now, "is there a loss of strength?" I think that there undoubtedly must be loss of strength. Mr. Reeves has done some very excellent work and I think his paper will be very valuable to many here in bringing to the notice of many of us these effects that they have on each other, but I think, had he not been using a valve amplifier giving very high amplification, he would not have got those results. When we are using very small magnification I think there will be a serious loss of strength. There is another point and that is that the selectivity depends more on the transmitting station than with the receiving apparatus, and that is a point which we have to remember. There does not seem to be much gain in making our receiving apparatus very selective when we have a station like Paris with a big damping. I think that is all Mr. President.

## Mr. C. F. Phillips.

I had the advantage of examining one or two of Mr. Reeves's coils with static couplers upon them and as I was extremely busy at the time I was unable to examine them as closely as perhaps they merited. I very soon discovered that coils of that nature were hardly suitable for combining within apparatus, owing to the space occupied. Again, in the design of receiving apparatus, it is generally found that one of the greatest difficulties is to get rid of stray electrostatic coupling. The use of electrostatic coupling to control magnetic coupling and the balancing of the two types of coupling one against

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the other, would undoubtedly provide an added means of obtaining selectivity at the receiving end. To do so in practice without a great deal of space at one's disposal would be a matter of serious difficulty; it would necessitate the receiving coils being separated by a distance of 1 ft. or even more, and it would necessitate all wiring within the set being run widely spaced, the greatest care being taken that all crossings should run at right angles to others. The result would be a set which would occupy dimensions quite impossible from a manufacturing point of view. When I say impossible it may be that such a set would be valuable in commercial working at stations designed to receive exclusively from another station having a fixed wavelength, but amateurs as a rule are not satisfied to receive on some one wavelength, but they nearly all desire to receive on all wavelengths from the shortest to the longest.

I have made some rough measurements on Mr. Reeves's coils, and I find that the capacity from static coupler to coil varies from 60 to 80 micro-microfarads. As in his circuit, two such couplers are in series, we get an effective capacitive coupling of 30 to 60 micro-microfarads. A coupling of that order is very reasonable because in some text books which describe such couplings I think it is very often said that the maximum value of the variable coupling condenser should be of the order of about 100 micro-microfarads.

As regards the previous use of circuits of this nature, I am afraid I am the culprit in stating that the principles are not entirely new. The actual static coupler is, as far as I know, very nearly new, although it was used by General Squier in his coil antennae. There is another circuit which Mr. Reeves can see in one of Scott-Taggart's books in which a plate is shown round the A.T.I.

I have had some personal experience of balancing static against magnetic coupling, and I have found the same effects as Mr. Reeves has described to-night. I was particularly interested in his first definition as to the necessity for having the two coils of a different rotation. In using three circuit coil holders I have noticed a marked increase in selectivity is sometimes obtained by reversing the leads to the primary coil; this effect is particularly valuable on short waves. If Mr. Reeves will produce a tuner by means of static couplers so selective as to get rid of some of the harmonics of GBL he has achieved a great object!

# The Performance of a Radio-Telegraphic Transmitter with Special Reference to the New Installation at North Foreland*

By NORMAN LEA, B.Sc., A.M.I.E.E.

## I. INTRODUCTION.

IN making a survey of publications devoted to radio-telegraphic work, the dearth of information in connection with the detailed behaviour of transmitting apparatus becomes evident at once. This fact is to be deplored, not only because the matter is of some scientific interest, but also on account of the fact that the progress in this branch of applied science is such that a particular design may become embodied in a large number of installations.

Although the transmitter dealt with in this paper possesses many interesting features, it is only proposed to describe it in sufficient detail to render the results which will be quoted properly intelligible.

The actual 1½ kW spark transmitter on which the measurements were made was later installed at the Post Office station at North Foreland, and has now been in operation for nearly a year. Another set of the same type is now being installed at the Post Office station at Seaforth, near Liverpool, and since many others have been fitted in ocean-going mail steamers, it will be realised that the results have more than a mere laboratory application.

## II. GENERAL DESCRIPTION OF THE TRANSMITTER.

The transmitter is designed primarily to handle traffic to and from ships at sea. It is capable of giving signals on any wavelength between 300 and 900 metres. Four working waves (usually 300, 450, 600 and 800 metres) are provided, any one of which may be brought into use by the operation of one hand-wheel.

Power is obtained from a motor-alternator of the two-bearing type having a frequency of 500 periods per sec. The output from this machine to the step-up transformer and primary high-frequency circuit is regulated by the adjustment of alternator excitation. Fixed tappings are provided on the alternator field regulator which correspond to full, half, and one-quarter power. A special form of synchronous spark-gap is mounted on the end of the machine and is fitted with a phase adjustment. A spark frequency of 1,000 per second is obtained by discharging the condenser once every half cycle, and this arrangement, of course, gives a note vastly superior to that obtained when using an alternator of lower frequency but with the same spark rate. The type of spark-gap employed has several important practical advantages over the stationary quenched gap sometimes employed. Some of these are:—

(1) The power may be changed without any readjustment of the gap whatsoever.
(2) The behaviour of the gap is sensibly the same whether it is hot or cold; no time is wasted, and no outside stations are interfered with at the time of starting up.
(3) The note is clear and very penetrating.

* Abstract of a paper read before the Institution of Electrical Engineers on Wednesday, June 7th, 1922.

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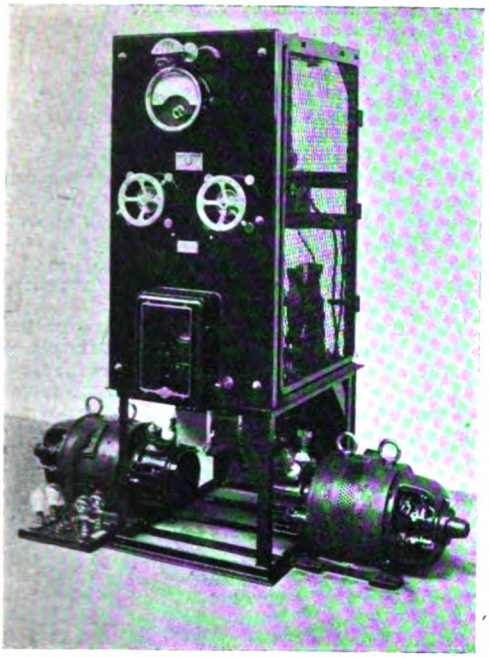


*The Transmitter showing duplicate Motor Alternators.*

(4) The efficiency is high, especially when judged by the only criterion which is of importance, namely, the ratio of power used to strength of signal received.

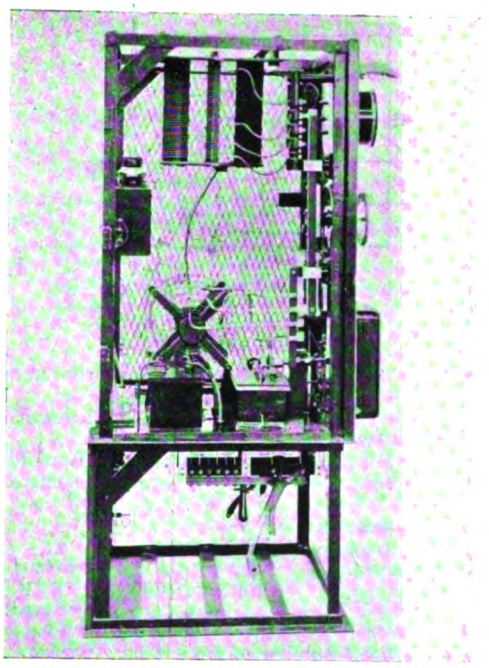
*Remote Control Board for Wavelength and Power.*

An emergency unit working on the Wilson principle is arranged to excite the same high-frequency circuits as are employed for power transmission. In the event of the main power supply failing, it is possible, therefore, to transmit on any one of the four waves without readjustment of tuning.

The general arrangement of the set and of the various details connected therewith will be best understood from the lantern slides.

III. DETERMINATION OF THE LOSSES.

When interpreting the results which follow, it is to be assumed, unless it is stated to the contrary, that the measurements refer to the conditions



*Side view of the Transmitter with one gate removed*

prevailing when transmitting on full power at 600 metres on an artificial aerial, and with the key depressed continuously.

(*a*) *Motor-alternator.*—The machine is of the two-bearing type with armature and rotor on the same spindle. Both stator and rotor are provided with windings, the former, which acts as the field, having 10 pairs of poles.

The losses were determined by the usual methods which need not be described. The figures are as follows :—

Total input (5·7 amperes at 480 volts) 2,730 watts.
Motor losses :

| | | |
|---|---|---|
| Armature (copper) | .. .. | 8·5 watts |
| Field (copper) | .. .. | 39·5 ,, |
| Iron, friction, windage of motor and alternator | .. | 415·0 ,, |
| Alternator losses : | | |
| Rotor (copper) | .. .. | 6·5 ,, |

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| | | |
|---|---|---|
| Field (copper) | .. .. | 149·0 ,, |
| Iron | .. .. | 519·0 ,, |
| Total | .. .. | 1,137·5 watts |

Motor efficiency = 83·2 per cent.
Alternator efficiency = 70 per cent.

(*b*) *Transformer.*—This is of the oil-cooled type wound for 500 periods per sec., the nominal voltages being 200 and 10,000 (R.M.S.).

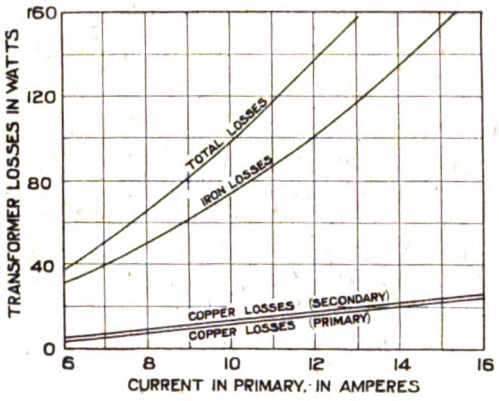


*Fig.* 1.

Copper losses at full power from the known resistances and currents are :—

| | | |
|---|---|---|
| Primary | .. .. .. | 12·2 watts |
| Secondary | .. .. .. | 18·8 ,, |

The total losses were obtained by the Hopkinson method and are shown plotted for various currents in Fig. 1.

At full power we find :—

| | | |
|---|---|---|
| Iron (hysteresis plus eddy currents) | .. .. | 95·0 watts |
| Total losses | .. .. | 127·0 ,, |
| Efficiency | .. .. | 91·2 per cent. |

(*c*) *Low-frequency choke.*—This consists of a coil having a fixed number of turns wound on an iron core of the two-window type, but with an air-gap in the centre limb. The copper losses and total losses were measured by a wattmeter for various sine-wave currents. These results are plotted in Fig. 2.

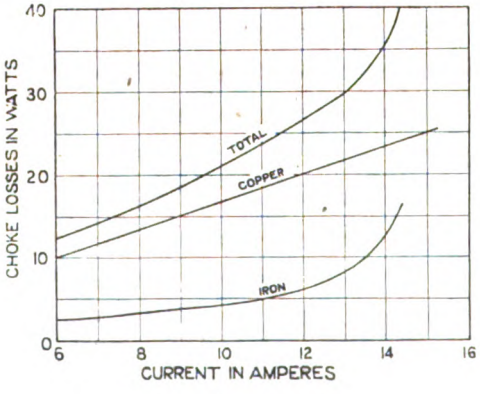


*Fig.* 2.

At the full power load the losses are :—

| | |
|---|---|
| Copper losses at working load | 20 watts |
| Iron losses at working load | 6 ,, |
| Total .. .. | 26 watts |

We now pass on to the H.T. side of the transformer where exact measurement becomes more difficult owing to the presence of high-frequency effects :—

(*d*) *Condenser of primary oscillatory circuit.*—This is of fixed value (0·01 $\mu$F) and is of the multiple-section mica-copper foil type, mounted in oil.

The losses in this are almost entirely due to the high-frequency discharge ; those due to the charging current at 500 periods per sec. may be neglected. The value of the losses was estimated by taking the temperature-rise at the end of a half-hour run at full power and comparing this with a curve (Fig. 3) of temperature-rises obtained by the use of a special heater placed inside the case. Oil was kept moving to ensure uniform results.

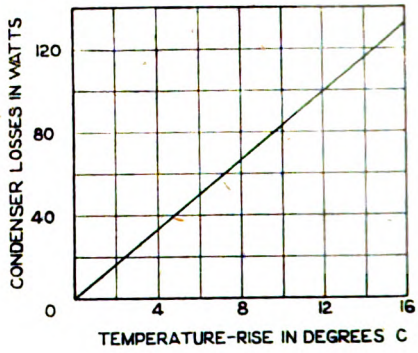


*Fig.* 3.

At the end of half an hour on full power with 600-metre high-frequency load, the temperature-rise was 4·0 deg. C., which, as may be seen from the curve, corresponds to a loss of 28 watts.

Since the high-frequency current at full power is of the order of 70 amperes, the effective high-frequency resistance of the condenser is only 0·0057 ohm.

(*e*) *Main spark-gap.*—The only method which can be applied here is one involving equal temperature-rises. A thermometer was fixed to a convenient part of the spark-gap case, and great care taken not to disturb either the thermometer or lagging used in connection therewith. Two separate half-hour runs at full power resulted in a temperature rise (as indicated by this thermometer) of 46 deg. C. in each case.

An attempt was made to employ a heat-substitution method, that is, to use a heater consuming a known amount of direct-current energy ; after several preliminary trials, however, it was abandoned as unlikely to give a reliable result. The arrangement shown in Fig. 4 was therefore set up with a view to introducing the equivalent heating effect at the proper part of the gap, namely, at the

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electrodes. The leads from the condenser to the gap were kept very short and heavy so that the whole of the energy minus transformer losses,

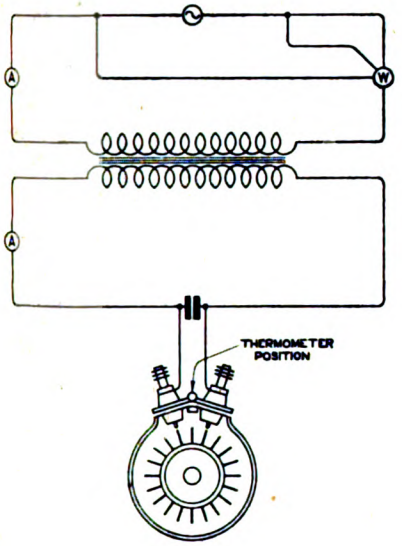


*Fig.* 4.

which had previously been determined, might be regarded as being dissipated in the gap. In this way a curve (Fig. 5) was developed giving the relation between watts turned into heat, and temperature-rise. Each point on the curve involved a half-hour run at full power.

From an examination of results obtained in this way it appears that after making allowances for heat conducted to the gap from the machine windings, the spark-gap has a loss of 410 watts and a mean effective resistance of 0·084 ohm.

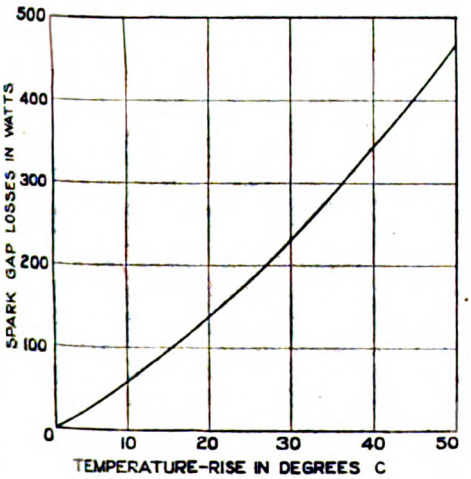


*Fig.* 5.

(*f*) The remaining parts of the primary circuit consist of comparatively low-resistance conductors, but the losses therein, as indicated by temperature-rise, are as follows :—

| | *Loss* |
|---|---|
| Primary inductance (copper strip wound edgeways) .. .. .. | 21·7 watts |
| Lead from condenser to switch (copper tube) .. .. .. .. .. | 14·0 ,, |
| Lead from switch to inductance (heavy flexible) .. .. .. | 7·0 ,, |
| Lead from inductance to switch .. | 7·0 ,, |
| Leads from switch to spark-gap .. | 14·0 ,, |
| Wave-change switch (estimated) .. | 5·0 ,, |
| Change-over switch (estimated) .. | 5·0 ,, |
| Total .. .. .. | 73·7 watts |

(*g*) *Artificial aerial.*—For test purposes an artificial aerial was employed consisting of a glass plate condenser in oil and having a capacity of 0·001 $\mu$F. The total length of lead, including "aerial" and "earth" connections, was 50 ft. The effective resistance of this arrangement was determined by inserting extra resistance of known values and noting the drop in aerial current when other conditions remained constant (Fig. 6). Curves were plotted, showing the relation between the added resistance and the reciprocal of the aerial current.

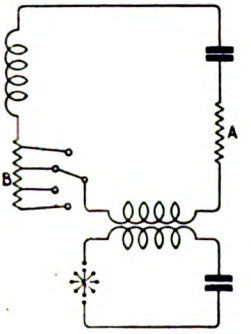


*Fig.* 6.

It must be remembered that these changes in the aerial circuit will be reflected back into the primary circuit to an appreciable extent unless the coupling is weak.

If the coupling is at normal value, the primary current will not be constant and hence the energy induced into the aerial circuit will be variable, with the result that the measurement of aerial resistance will be inconclusive.

It is obvious that if the coupling be tightened we shall be approaching the conditions which apply to an ordinary transformer, where the resistance in the primary can be regarded as being replaced by a resistance in the secondary, and can be calculated if the square of the transformation ratio is used as a multiplier. In other words, with tight coupling any reading of aerial resistance by the method proposed will give a fictitiously high value.

Curves are shown in Fig. 7 for various couplings, and it is found that when the primary and secondary are 18 cm. apart, a reliable result is obtained. By

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drawing a tangent to the uppermost curve at the point corresponding to the test current, we find that the effective resistance of the condenser, aerial inductance, ammeters and 50 ft. of lead is about 9 ohms.

The aerial-earth resistance at North Foreland is rather high on account of the chalky nature of the site. The full-power tests were, therefore, carried out with a series resistance which gave approximately the correct aerial current in order to imitate the actual working conditions.

### IV. POWER BALANCE SHEET.

| | | | |
|---|---|---|---|
| *Total power from mains* 5·7 × 480 | | | 2,730 |
| *Losses in motor-alternator and field circuits.* | | | |
| Motor: Armature copper .. .. | 8·5 | | |
| Field .. .. .. | 39·5 | | |
| Field regulator .. .. | 11·0 | | |
| Total iron losses, windage and friction, including alternator .. .. | 415·0 | | |
| | 474·0 | | |
| Alternator: Rotor copper .. .. | 6·5 | | |
| Field copper .. .. | 149·0 | | |
| Field regulator .. | 29·0 | | |
| Total iron losses .. | 519·0 | | |
| Total motor-alternator losses .. | 1,177·5 | | |
| Guard lamps.. .. .. .. | 85 | | |
| | 1,262·5 | | |
| Errors of experiment .. .. | 37·5 | | |
| | | | 1,300 |
| Wattmeter reading .. .. .. | | | 1,430 |
| *Losses in transformer.* | | | |
| Primary copper .. .. .. | 13·2 | | |
| Secondary copper .. .. | 18·8 | | |
| Iron .. .. .. .. | 95·0 | | |
| | 127·0 | | |
| *Losses in choke.* | | | |
| Copper .. .. .. .. | 20 | | |
| Iron .. .. .. .. | 6 | | |
| | 26 | | |
| | | | 153 |
| Balance (power input to high-frequency primary) .. .. | | | 1,277 |
| *Losses in primary high-frequency circuit.* | | | |
| Condenser .. .. .. | 28 | | |
| Spark-gap .. .. .. | 410 | | |
| Inductance .. .. .. | 22 | | |
| Leads .. .. .. .. | 42 | | |
| Switch contacts .. .. .. | 10 | | |
| | | | 512 |
| Balance transferred to aerial circuit | | | 765 |
| *Losses in aerial circuit.* | | | |
| Added resistance, $6·6^2 \times 8$ .. | 348 | | |
| Aerial condenser, two aerial ammeters, aerial tuning inductance, coupling coil, 50 ft. earth wire, $6·6^2 \times 9$ .. .. .. | 392 | | |
| Losses unaccounted for .. .. | 25 | | |
| | | | 765 |

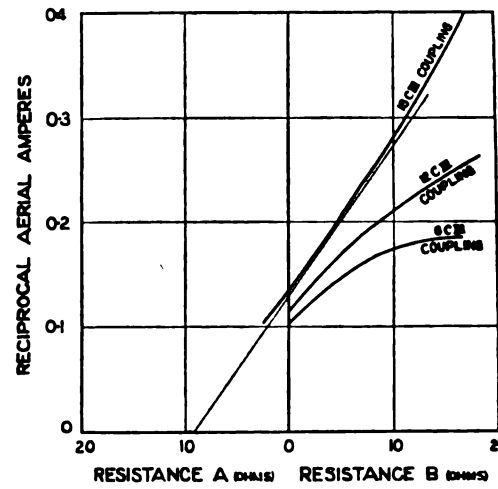



*Fig. 7.*

### V. RESULTS UNDER TRAFFIC CONDITIONS.

As a result of tests extending over a period of two years, the reliable working ranges of the transmitter may be taken to be:—

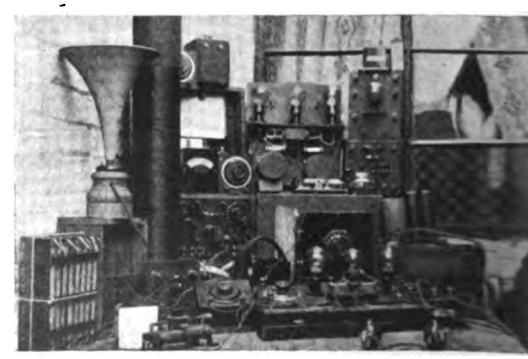
By day 6 H nautical miles.
By night 15 H „ „

where H is the height of the transmitting aerial in feet above the sea level. These figures are for cases where signals are received without high-frequency amplification.

We are indebted to the Radio Commmunication Company, Ltd., for the loan of the photographs used in illustration of this paper.—[ED.].

## A STOKE-ON-TRENT STATION.

The accompanying photograph shows a neat station designed by Mr. A. H. Wilson, of Stoke-on-



Trent, a prominent figure in the local wireless society. The apparatus is almost entirely home-made, and is the result of a long series of experiments.

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# How to get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.
(Author of " The Maintenance of Wireless Telegraph Apparatus.")

## III.—THE SELECTION AND CARE OF ACCUMULATORS.

EVERY wireless enthusiast who decides to install a valve receiver is immediately faced with the problem of current supply for his valve filaments. In the case of some of the newer valves, known as " dull emitters," the current required to heat the filaments is considerably less than that required by the ordinary types, and can be supplied from large dry cells. In the majority of cases, however, the ordinary type of valve, taking about two thirds of an ampere, is used, and for these the only satisfactory source of current is the accumulator.

Accumulators are of two types. The first, and most generally used, consists of prepared lead plates immersed in an acid solution. The second, frequently known as the " Edison " type, contains nickel steel grids containing nickel peroxide and spongy iron immersed in a solution of caustic potash Each type has its advantages. A discussion of the relative merits is, however, beyond the scope of this article.

Probably there is no part of a wireless installation which gives more trouble to the beginner than the accumulator battery, and certainly no part better repays attention to its peculiarities. Its maintenance in good order will best be understood if we consider first of all the requirements of a good accumulator and the demands made upon it.

Take first the lead accumulator. Each unit of a lead accumulator supplies, when fully charged, a current at a pressure of about two volts for a time, which depends upon the strength of the current and the capacity of the cell. If a strong current is taken from the cell it will last for a shorter time than it would if it were weaker. Accumulators are therefore rated in ampere-hours, and if the capacity is marked on the cell as " 80 Ampere-Hours," this means that it will supply a current of 8 amperes for ten hours, 4 amperes for twenty hours, 2 amperes for forty hours, and so on. Thus to find the length of time during which a particular current can be drawn from a cell, it is only necessary to divide the current in amperes into the total capacity in ampere-hours.

It must not be imagined from this that one can take a current of say 80 amperes for one hour. The rule above given only applies within reasonable limits, and the maximum safe steady current that can be taken from a cell for a considerable period without interruption is usually reckoned as about a tenth of its ampere-hour capacity. For the typical cell we have quoted, this would be about eight amperes. If we greatly exceed this figure the cell will be injured for reasons which will shortly be explained and the total capacity will work out at a considerably lower figure. Very short discharges at a much higher figure than that quoted can, however, be made without injury, as is done in the case of accumulators used for motor-car starters. The wireless man is only interested in the continuous discharge of his cells, and the above rule will be found a good one to work on.

Owing to the fact that accumulators are so largely used in motor work for ignition purposes, many cells are marked " ignition rating . . . . . ampere-hours." This figure is not the continuous discharge rating, but a special rating decided upon by the car manufacturers for the particular purpose quoted. It is exactly *double* the continuous discharge rating, and this fact should be borne in mind when purchasing and using such cells. When cells are purchased for wireless work, the purchaser should insist upon knowing the continuous discharge or " actual " rating.

Many people are under the impression that an accumulator actually stores electricity. Speaking in very broad terms, this is true, for electricity put into the cell can be subsequently withdrawn (or at least, a high proportion of it). Actually, however, the energy is stored in chemical form, the charging current acting upon the lead preparations on the positive plates,and negative plates in such a way that they are converted into substances, which, when the charging current is withdrawn, act with the acid and produce a current through a circuit connected to them. Electrical energy is thus first converted into chemical energy, and later, re-converted into electrical energy.

From the above explanation it will be understood that the plates and the preparations upon them need careful attention in making a cell. The total capacity of a cell depends upon the *total area of active material* in the electrolyte,or liquid in which the plates are immersed. Double the active plate area, and you will double the total capacity. Reduce the area of active material from any cause, and the capacity will be correspondingly reduced. This reduction of active area can very easily take place when the cell is badly handled, and is one of the chief causes of trouble amongst wireless men.

The reduction of effective area can take place in several ways. Too rapid a discharge will loosen the active material and cause it to fall to the bottom of the container, where it not only serves no further useful purpose, but will most likely short-circuit the plates if much is deposited. This excessive discharge rate will also cause the plates to expand and bend, which may develop into short-circuiting and general trouble.

A cell must never be left discharged for any lengthy period. As soon as the safe limit of discharge is reached (this will be explained later) the cell should be charged again without delay. Cells left in the discharged state will gradually develop upon their plates a white, practically insoluble coating of " sulphate" which reduces the active area and can only be removed by prolonged treatment and expert attention, and then only when the sulphating is not excessive. If a cell which normally has a capacity of say 80 ampere-hours has half of its active material covered with a coating of insoluble sulphate, the normal discharge rate of say 8 amperes may then prove excessive and may cause buckling and disintegration. Sulphating may also be caused by using too strong acid solution, by leaving the cells partially discharged for long periods, and by under charging.

*(To be Continued.)*

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# Experimental Station Design*

*These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## VI. A SIMPLE TESTING BUZZER AND WAVEMETER.

FOR the purpose of setting the crystal to its most sensitive adjustment it is necessary to have a buzzer set up to produce feeble oscillations, and if arranged to transmit oscillations of a definite frequency an additional purpose will be served whereby the receiving circuit may be adjusted to the particular wavelength on which it is desired to receive, at the same time as the most sensitive point is found on the crystal detector. Such a transmitter of oscillations of definite frequency constitutes a wavemeter. As the two tuners described in the previous article were designed essentially for the reception of broadcasted telephony on 350 to 450 metres, a wavemeter designed to give oscillations on a wavelength of 400 metres will be particularly useful for the adjustment of such sets enabling all necessary adjustments to be made prior to the reception of the expected signals.

The inductance to be used for the construction of the wavemeter is that already described and shown in Fig. 4, page 328*, and a suitable condenser for use in conjunction with this inductance it is shown in Fig. 1. As it will be the object of most experimenters reading these articles to make their own apparatus, the construction of the condenser is given in precise detail and those with very little workshop experience are advised to take this as a practice exercise in which to gain a little skill in the manufacture of simple wireless apparatus. The materials required for making up the condenser are :—

1 piece of ebonite, 4″ × 1½″ × ¼″, with polished faces.
4 pieces of "ruby" mica, ¾″ × 1½″ × two thousandths of an inch thick.
4 6 B.A. × ⅜″ screws, countersunk heads.
4 6 B.A. nuts and washers.
1 4 B.A. × ¾″ screw, countersunk head.
3 4 B.A. nuts and washers.
4 No. 4 × ½″ wood screws, round heads.
Sufficient No. 38 to 40 gauge hard copper foil for making three strips, 1¾″ long × ⅜″ wide.

All the screws and nuts to be of brass and can be obtained from any ironmonger or together with the ebonite and mica from an electrical store, for a small sum.

The procedure for making the condenser is as follows :—Holding the ebonite in the vice with its faces wrapped with paper to prevent them becoming damaged, one of the long edges is carefully trued up with a medium file. A rule placed along it will indicate when it is perfectly true and the eye can

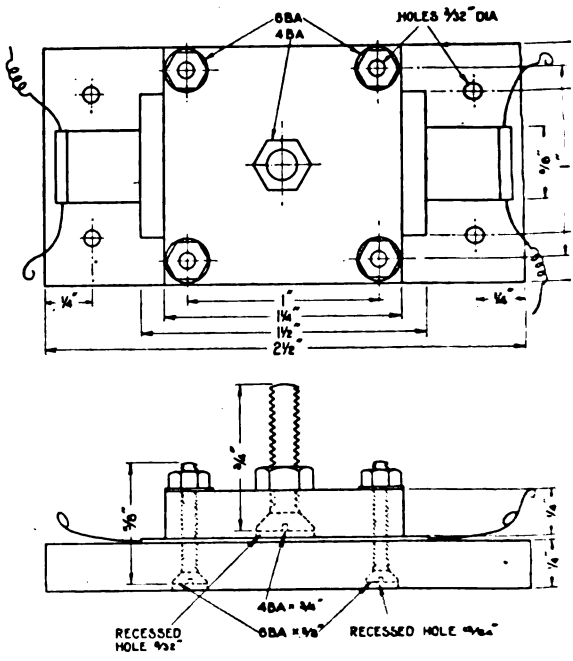


*Fig. 1. Working drawing of 400 m. wavemeter condenser.*

be used to judge as to whether it is at right angles to the faces. Next, with the aid of a square, mark off a scratch line across one end at right angles to the trued edge and carefully square this end up. Mark a scratch line again at right angles to the finished edge, exactly 2½″ from the trued end and holding the ebonite in the vice, saw off the spare portion, going as near to the line as possible but not sawing it away. Care must be taken on nearly

* *The Wireless World and Radio Review*, June 10th, 1922.

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completing the saw cut that the remaining uncut portion does not snap. This edge is next trued up to the line and square to the longer edge. Measuring from the trued edge along the two ends mark off 1¼" for the width and join the two points with a scratch line and file down true. To finish the edges, rub them on a piece of emery paper, which is tacked down to a piece of true wood, taking care to keep the ebonite standing vertically and at right angles to the emery paper, and giving even pressure along the whole edge. Eight holes must be made in this piece of ebonite as shown in the figure, which is drawn to scale. Those in the corners are for the No. 4 wood screws and a Morse twist drill No. 28, or approximately 7/64", will give the necessary clearance. After marking the position for the holes, small dots must be made with a sharp centre punch to act as a guide to the drill and so prevent it wandering over the smooth face of the ebonite when commencing to make the holes. To prevent the ebonite bursting out at the back whilst drilling through, it should be held in the vice with a piece of scrap ebonite or hard wood, clamped tightly against the back face. The No. 28 drill will also be suitable for making the other holes which are to give clearance for the four 6 B.A. screws. A little more care is required in the making of these holes than with the others owing to their nearness to the edge. It will be seen from the drawing that the heads of the 6 B.A. screws are recessed into the under side of the larger piece of ebonite. This is done with a No. 6 Morse twist drill, or 13/64", using these to hold the two pieces of ebonite together with screws and nuts, the other two can be put through accurately. A 5/32" hole is also made in this piece at the point of intersection of the two diagonals, to carry the 4 B.A. screw. A 9/32" drill will make a hole of suitable size to give clearance for its head. A good matt finish to the ebonite is obtained by rubbing the faces with very fine emery paper stretched tightly across the face of a small piece of wood, and by rubbing in small circles all the gloss will be removed, yet at the same time the surface will be entirely free from scratches. This treatment also improves the surface insulation. Having completed the ebonite portion, the next consideration is the mica, and in cutting it to size one must be careful not to split it or fracture the edges. The copper foil that serves for the plates must be cut very accurately to width, as any variation will materially alter the required capacity. In assembling, one piece of mica is placed on either side of a copper strip, then the other two strips with ends projecting out in the opposite direction to the first are placed in position, together with two more mica plates to protect the outer faces. The overlap, and this is important, must be precisely one inch and it must be seen that the edges of the plates completely coincide. When once the plates are in position the ends of the mica can be held down by finger nails while an assistant places the top ebonite plate in position. This completes the construction of the condenser except for making connection to the ends. The projecting foil must be carefully

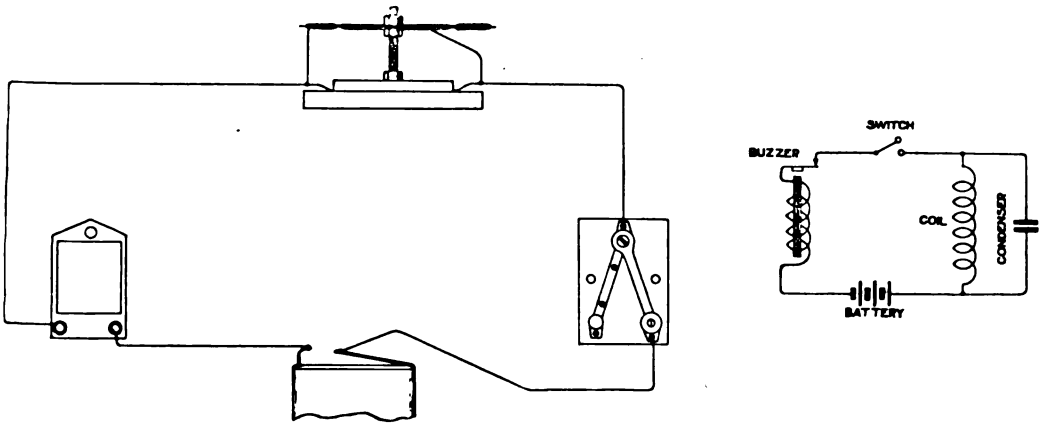


*Fig. 2. Method of connecting up the tuned buzzer circuit.*

taking care to get the depth uniform in each hole and no deeper than is necessary to prevent the heads from projecting above the surface of the under face. The remaining piece of ebonite is used for the construction of the top clamping-down piece, and the method of bringing down to dimensions, is as already described for the base piece, by working for trueness from the one edge that is already squared off. In order that the holes through its corners may coincide with those in the piece already made, the two pieces should be held together in the vice in the correct position and the holes drilled through into the smaller piece from those already made. Make two of the holes, and scraped and then thinly tinned, using resin or "Fluxite" for cleaning. The tinned ends are then wrapped round a piece of tinned copper wire, which projects through, with about ½" on one side and 4" on the other, and with a hot iron the solder can be made to run and fix the wire in position. The screw in the middle of the top of the condenser is for the purpose of holding the flat inductance coil which is clamped between two 4 B.A. nuts, with washers. The advantage of this form of mounting is that it prevents any stray capacity being brought near the coil, either by screws that may be in the woodwork near by, making a bigger capacity across the turns or by the coil itself, having a capacity



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through the earth to the other components of the circuit.

In the description of the construction of the coils it was mentioned that they might be wound with either single cotton or double silk-covered wire. Both wires will give nearly equal inductance and their values are made practically identical by immersing the cotton-covered wire inductance in paraffin wax and not so treating the silk-covered one. The ends of the inductance are soldered to the two shorter leads of the condenser which may be still further shortened in order that there may be no surplus wire which would increase the inductance of the circuit. Other leads are taken to a small buzzer, battery and switch, connected as in Fig. 2, and for the benefit of those unaccustomed to circuit diagrams the connections are also represented in the manner usual in wireless circuits, in order that they may acquire a little knowledge of the meaning of such diagrams. It is not thought necessary to give instructions on the making of a buzzer as it involves quite a lot of work and one of reliable make can usually be purchased for about two shillings. The contacts of the buzzer should be adjusted to give a note of high pitch, and this can be done by wedging small pieces of paper between the magnet ends and the armature, and the armature and its spring contact piece. The battery is of the type used for small pocket lamps, although if the buzzer is of good make it should be able to be operated from a single cell, in which case one of the large cylindrical type is to be recommended and will have a much longer life than a small pocket lamp battery. The components of the wavemeter may be mounted on a small board for the convenience of making the connections between the various parts permanent. This wavemeter is designed to give a wavelength of 400 metres and can be relied upon to be within plus or minus twenty metres, if the details with regard to condenser and inductance construction are carefully followed. An advantage of belonging to a Wireless Club may be pointed out here, for the finished instrument can then be tested against a standard wavemeter, usually of the "Townsend" type, which most clubs possess.

A few remarks in the method of operation may be necessary for the novice. Having installed his set and laid it out in the form shown in Fig. 5 of the previous article, he must place the wavemeter a few inches away from the flat coils, with the plane of the wavemeter inductance parallel to that of the coils in the aerial circuit. The buzzer is set in operation, and after having adjusted the crystal until a buzz is heard in the telephone receivers, the coils are moved relative to one another until the buzz is of maximum strength. The nearer the wavemeter is to the aerial tuning coils, of course the stronger is the buzz and one is cautioned against confusing an improved signal strength produced by the movement of a coil, if by its movement it is being brought nearer to the wavemeter coil. To obtain the adjustment of maximum sensitiveness on the crystal and the correct setting for the coils, the wavemeter should be moved farther and farther away from the set until the buzz in the telephone receivers is a minimum, and when any change is made in the circuit the sound disappears. When these adjustments are affected the buzzer may be switched off and the installation is ready to receive on 400 metres. As transmissions may be 50 metres either side of this adjustment, a very slight further movement of the coils will make the necessary change. Practice will soon acquaint the experimenter with the direction and amount of movement required to make the requisite increase or decrease of wavelength.

* * *

This completes the description of crystal receiving apparatus suitable for the reception of broadcasted telephony. Crystal receivers are only suitable for the reception of damped wave signals, such as those sent out by telephony and spark transmitters. Most ship and coast stations employ transmitters of the damped wave spark type and their signals will probably be heard during the adjustment of the apparatus as these stations usually work on a wavelength of 600 metres, though they are capable for particular purposes of using wavelengths of 300, 450 and 800 metres. Time signals are transmitted by the Eiffel Tower (call sign FL) on 2,600 metres and can be received on the set described by adding some ten extra coils, which are connected in the aerial circuit in the same way as the two for the short wavelengths, that is, in series. The times and mode of transmission of these time signals have been given from time to time in this journal and can also be found on pages 1,146 to 1,148 of the "Year-Book of Wireless Telegraphy and Telephony 1922," (Wireless Press, Ltd.). This book will also be found useful for identifying the stations whose call signs are heard, should the experimenter gain a knowledge of the Morse code, which he is strongly recommended to do as it considerably extends the scope and pleasure afforded by the set. As it usually takes some time to acquire a receiving speed of twenty words a minute, it is as well to commence a study of the Morse code in the first stages of experimenting or otherwise one is apt to acquire a habit of listening to signals without concentrating on what the signs signify and it becomes much more difficult at a later stage to concentrate and follow sounds which have hitherto conveyed nothing. If a cheap telegraph key is purchased, it may be connected in place of the switch shown in the diagram of the wavemeter circuit and used to practise the formation of the letters and to memorise their sounds. For the purpose of listening to the buzzed signal, the telephone receivers may be connected across the ends of the wavemeter inductance, which will then act as a shunt and prevent too much current being passed by the telephones, which would tend to reduce their sensitivity.

## VII. SIMPLE VALVE PANEL.

The construction of a simple valve receiving set will now be considered. The making up of such apparatus involves a good deal of care but the reader is strongly advised to follow the drawings and instructions precisely and produce apparatus of good finish. The following parts will be required, and details for their assembly, together with working instructions, will be given in a subsequent instalment:—

Polished ebonite sheet, 6" × 6" × ¼".
2 ounces No. 22 S.W.G. tinned (or bare) copper wire.

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2 ounces No. 22 S.W.G. "Eureka" resistance wire.
2 yards "Sistoflex" insulated sleeving.
20 pieces "ruby" mica, $\frac{3}{4}$" × $1\frac{1}{2}$" × two thousandths.
4 valve stems with back nuts and washers.
1 O. B.A. terminal, tall type, with screw-on top, with back nut and washer.
12 4 B.A. × $\frac{3}{4}$" round-headed brass screws.
8 6 B.A. × $\frac{3}{4}$" ditto.
2 4 B.A. × 1" ditto.
4 $1\frac{1}{2}$" × No. 6 brass wood screws.
26 4 B.A. brass nuts.
8 6 B.A. ditto.
36 4 B.A. thin stamped washers.
12 6 B.A. ditto.
Strip of hard brass, 20 S.W.G. gauge 6" × $\frac{1}{4}$".

F.H.H.

*(To be continued.)*

# A Broadcasting Receiver.

## A TYPE OF MARCONI APPARATUS FOR GENERAL USE.

AT the present time when everyone, whether connected with wireless or not, is at least interested in the prospect of the early introduction of the broadcasting service, it may be of interest to readers to see photographs of the type of apparatus which it is likely will soon be supplied in quantities to listeners in. The instrument which we are illustrating here is a two-valve receiver manufactured by Marconi's Wireless Telegraph Co., Ltd., and specially designed to meet the requirements of the broadcasting service. Apparently every endeavour has been made by the manufacturers to render the apparatus as simple in operation as possible, so that no skill in the manipulation of the wireless apparatus is necessary on the part of the owner in order to get the best results from the instrument. Our illustrations show the set with the top open and lying on its side and also the same instrument closed with telephones and battery external to the set. We understand that

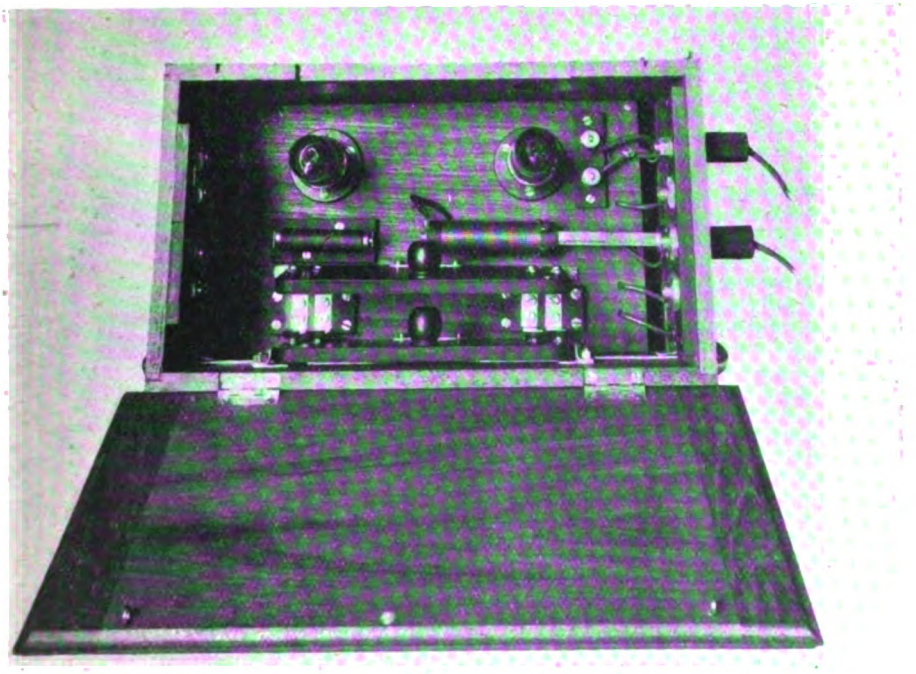

*Fig.* 1. *A view of the Marconi Broadcasting receiver showing the internal arrangements.*

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the valves to be used will be either the ordinary French pattern when accumulators will be needed, or valves of the new low temperature type, the filament current for which can be obtained from dry cells, so that all that is needed will be two dry batteries, one for filament heating and the other supplying the plate voltage.

Looking down into the instrument with the lid open as in Fig. 1, the two valves can be seen side by side, whilst below the left-hand valve is a small cylindrical piece of apparatus which is the grid leak and condenser. To the right of this is the filament resistance, controlled by a knob protruding from the side of the box. Below these are two ebonite enclosed inductance slabs fitted with ebonite knobs for handling. The upper one of these is a spare whilst the lower is in operation in the position shown in the photograph. The connection is made by means of spring clips and the ranges are suitable to cover those allocated to the broadcasting of telephony. Plugs for the telephones allow for one or two pairs of telephones to be used at will and there are three separate plugs for the aerial wire, in order that aerials of varying lengths may be used where circumstances necessitate this being done. For fine tuning two plates connected to external knobs and arranged behind the slab inductances. The position of these with respect to each other and to the inductance slab can be varied and by so doing fine tuning can be obtained. The plate battery is located in the base of the instrument, a small door in the side of the box giving access to this. An interesting little booklet entitled "The Marconiphone" has been received by us from Marconi's Wireless Telegraph Company, which deals with the subject of broadcasting in a popular manner and describes types of receivers which they are putting on the market for broadcasting purposes.

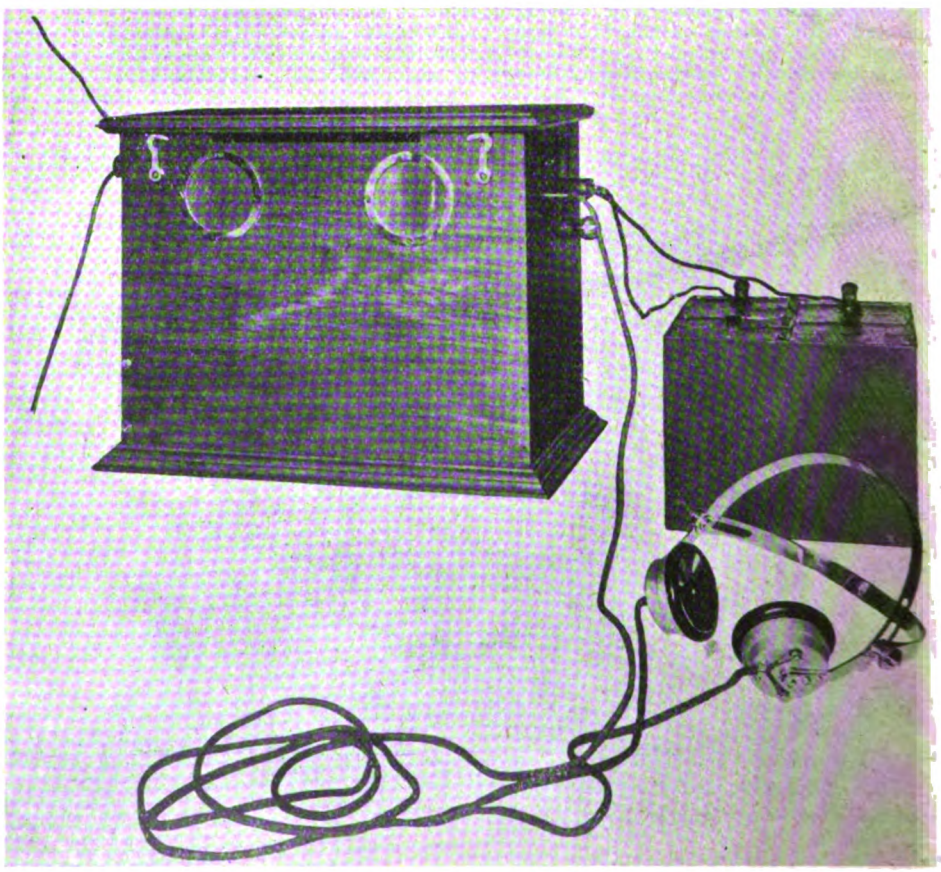

*Fig. 2. General view of the complete instrument with telephones and battery.*

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# Notes

**Radio Instruments, Ltd.**

Radio Instruments, Ltd., is the name of a new company formed for the production of wireless instruments of new design. Mr. J. Joseph, M.I.E.E., who has recently resigned his position as general manager for Mr. H. W. Sullivan, is managing director of the new company, and has been associated with the design and manufacture of wireless instruments for very many years. Mr. W. A. Appleton, M.B.E., M.I.R.E., late Admiralty Technical Research Officer at H.M. Signal School, Portsmouth, has been appointed Director of Research and Chief Designer to the company, which has an illustrated and descriptive catalogue in course of preparation. The works, offices, and show-rooms are situated at 12a, Hyde Street, New Oxford Street, London, W.C.1. A special department will deal with laboratory standards and radio measuring instruments, and the company will also advise on high frequency and radio work.

**Radiola Wireless Telephone Parts Co.**

Radiola Wireless Telephone Parts Co., Ltd. (182,102.)—Private company. Reg. May 27th. Capital £8,000 in £1 shares. Manufacturers, importers and exporters of and dealers in wireless telephones and telephonic and telegraphic apparatus, parts and accessories, etc. First directors: W. Mansfield and J. F. Little. Secretary: W. Mansfield. Registered office: 17, Brunswick Street, Liverpool.

**Wireless Society for Dublin.**

Referring to a note published in a recent issue Mr. H. L. Fletcher of School House, Oundle, Northants, notifies us that he is unable to reply immediately to all the communications he has received, and at present he is in communication with the authorities in the hope of getting the necessary permission for the formation of a Society some time in August of this year.

**A Correction.**

It is regretted that in the article on "Simultaneous H.F. and L.F. amplification," by Mr. Voigt, published in our issue of May 27th, Figs. 3 and 4 have accidentally become interchanged.

**Amendments to List of Wireless Societies.**

**Omitted:**

SUNDERLAND WIRELESS AND SCIENTIFIC ASSOCIATION.
Technical College, Sunderland.

WIRELESS SOCIETY OF HIGHGATE.
13a, Sedgemere Avenue, East Finchley, N.2.

SUNDERLAND DISTRICT WIRELESS SOCIETY.
1, Dryden Street, Southwick-on-Wear.

**Addresses incorrect, to be amended to:**

BRISTOL AND DISTRICT WIRELESS ASSOCIATION.
10, Priory Road, Knowle, Bristol.

LEAMINGTON, WARWICK AND DISTRICT RADIO SOCIETY.
31, Archery Road, Leamington Spa.

GLASGOW AND DISTRICT RADIO CLUB.
40, Walton Street, Shawland, Glasgow.

WALLASEY WIRELESS AND EXPERIMENTAL SOCIETY.
106, Albion Street, New Brighton.

**Personal.**

Mr. G. G. Blake has recently been elected a Member of the Institution of Electrical Engineers.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was interested to see that Aberdeen has been selected as one of the proposed "broadcasting" centres. I wonder, however, if the authorities have taken into account the proximity of Stonehaven (GSW), which is about 14 miles from Aberdeen, and intend to take any steps to regulate the transmissions from this station during broadcasting hours.

At present when GSW is working I think I am safe in stating that telephony reception on *any* wavelength is almost impossible within a radius of 50 miles from the station, owing to the powerful harmonics which it radiates.

I am situated within 40 miles of Stonehaven and have tried various selective circuits but find it impossible to tune out the violent "bubbling and hissing" of the high speed transmitter, which works nearly continuously, and I know all amateurs in the Aberdeen district are similarly affected.

This afternoon the Dutch concert, which was coming through splendidly at 3 p.m., has since 3.10 been completely "wiped out" by him.

"EXPERIMENTER."

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—May I be permitted to encroach on your valuable space in order to make an appeal to amateurs transmitting telephony to use the Phonetic Alphabet printed in the issue of *The Wireless World* for January 7th, 1922, when giving their call letters?

The majority of call letters seem to be given much too quickly and very indistinctly, and in these circumstances it is almost impossible to distinguish between the letters "Q" and "U" such as happened the other evening.

"THERMIONIC."

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In reference to Mr. William Le Queux's letter in last week's *Wireless World and Radio Review*, may I be permitted to say a word in defence of the amateur so severely criticised by him.

Personally I have not troubled a jot about the mysteries of the functions of valves, transformers, and various other paraphernalia necessary to the working of a valve reception set, but at the same time I have learnt sufficient to understand why and how a set works to enable me to carry out the experiments I set myself to do from time to time.

When it comes to telling friends and visitors (of which I get a goodly number) the functions of every

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piece of apparatus on the set, it is absolutely out of all reason, in the first place the said friends, etc., are, as a rule, ignorant of even the elementary principles of electricity and magnetism, and in my opinion, to tell them of the manner in which stations are allotted different wavelengths, and the said W.L. explained by simple analogy, and in the case of valve sets that the detector, as its name implies, detects the incoming signals and the others, if any, magnify them to the strength heard in the telephones, the said friends, etc., are far more satisfied than if one was to pile a ton of technical "lingo" into them; they may, I admit, go away amazed "at the wonderful knowledge of Mr. So and So" but the chances are that they would say the same thing (if that is any satisfaction to operator) if they are told in simple non-technical terms the way in which the set works.

There is only one thing the amateur who is contemplating installing, or who has already got a set, can do to obtain a working knowledge of wireless reception sets, and that is to join the local wireless society, the secretaries of which will always be pleased to enrol them and give all particulars of their respective societies.

L. W. BURCHAM.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—While reading the article on a simple C.W. and telephony transmitter by B. J. Axten in your issue of the 3rd inst., it occurs to the writer that a word of warning may be helpful to amateurs when deriving their transmitting power from A. C. Public Supply Mains used for their house lighting, and while the author may have used it successfully, his description of the supply in his district would lead one to suspect that his wireless knowledge was superior to that of the power circuit.

In all such cases it is advisable to emanate power for the transmission from a double-wound transformer to ensure that neither side of the A.C. source of supply is earthed elsewhere.

It is distinctly contrary to the regulations of supply authorities, insurance companies, the Post Office and the like to earth any point of a lighting installation fed from a public supply, notwithstanding that, as the author suggests, that this may be done through the resistance of a lamp and in the hands of the average amateur it is quite possible under abnormal conditions to burn out this particular lamp.

The regulations largely have reference to the prevention of electrolysis and the use of the double-wound current transformer suggested entirely obviates any transgression of the regulations referred to.

INTERESTED.

# Books Received

How to Make Commercial Type Radio Apparatus, by M. B. Sleeper. (New York: The Norman W. Henley Publishing Company, 1922. Pp. 159. 7½" × 5". 75 cents.)

# Calendar of Current Events

**Saturday, June 24th.**

WIRELESS SOCIETY OF HIGHGATE.
Field Day. Outing to Ken Wood.

**Sunday, June 25th.**

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, June 27th.**

Transmission of Telephony at 8 p.m. on 4(00 metres by **2 MT**, Writtle, near Chelmsford.

**Wednesday, June 28th.**

NORTH MIDDLESEX WIRELESS CLUB.
7.30 *p.m.*—At Shaftesbury Hall, Bowes Park. Elementary Lecture for Beginners.
8.30 *p.m.*—Lecture, "Miscellaneous Applications of the Thermionic Valve," by Mr. W. Gartland.

**Thursday, June 29th.**

RADIO EXPERIMENTAL ASSOCIATION (Nottingham and District).
7.30. Room 74. Mechanics Institute. Meeting.
WALLASEY WIRELESS AND EXPERIMENTAL SOCIETY.
7.30 *p.m.*—Meeting.

**Friday, June 30th.**

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part III, by Mr. J. Stanley.

**Saturday, July 1st.**

CROYDON WIRELESS AND PHYSICAL SOCIETY.
Meeting.

**Sunday, July 2nd.**

Transmission of Telephony from the Hague, **PCGG**, as above.

**Monday, July 3rd.**

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.
7.30 *p.m.*—Annual General Meeting for Election of President and Officers.

**Tuesday, July 4th.**

Transmission of Telephony from Writtle, **2 MT**, as above.
ILKLEY AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At the Regent Café, Cowpasture Road, Ilkley.
8 *p.m.*—Lecture and Demonstration on "Short Wave Telephony Reception."

**Wednesday, July 5th.**

FOLKESTONE AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At Cave's Café, Sandgate Road, Meeting.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.*—[ED.]

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# A Rectifier for Alternating Current

## A NEW INSTRUMENT FOR HOME CHARGING OF ACCUMULATORS ADAPTABLE TO ANY VOLTAGE

THE apparatus is designed to provide a current suitable for accumulator charging from alternating current public supply mains. Fig. 1 shows the outfit mounted in panel form, and Fig. 2 the circuit diagram. The mains are fed to a step-down transformer of the usual closed core pattern, and a simple polarised vibrator permits current only of the proper polarity to pass to the battery. The polarising of the armature is effected by the current from the battery on charge, and consequently it is immaterial as to the direction in which the battery is connected. If the battery is disconnected the machine ceases, for without polarisation the armature would be pulled towards the pole piece on each half cycle, and consequently at twice its normal speed of operation, and the natural period of swing of the armature prevents it oscillating at such a high rate. The natural period of oscillation of the vibrator can be adjusted through a limited range by means of a damping screw near the point of suspension, to make the apparatus suitable for use on circuits of various periodicities. Magnetic damping is provided by causing the lower end of the armature to cut the lines of force set up by the polarising coil, and thus allows for any temporary fluctuation of periodicity or interruption of current from the mains.

The instrument illustrated is marketed under the name of the "Homcharger," and the manufacturers claim that it can deliver a charging current equivalent to that of 8 amperes direct current.

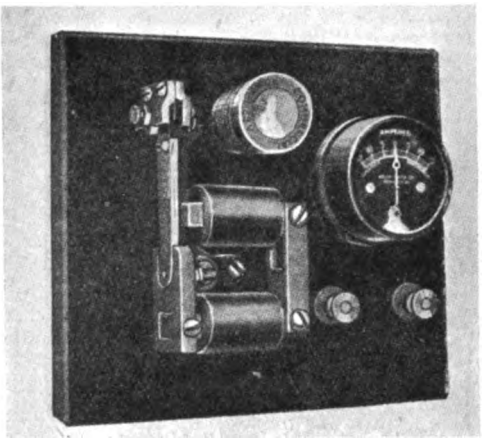

*Fig. 1. An illustration of the instrument.*

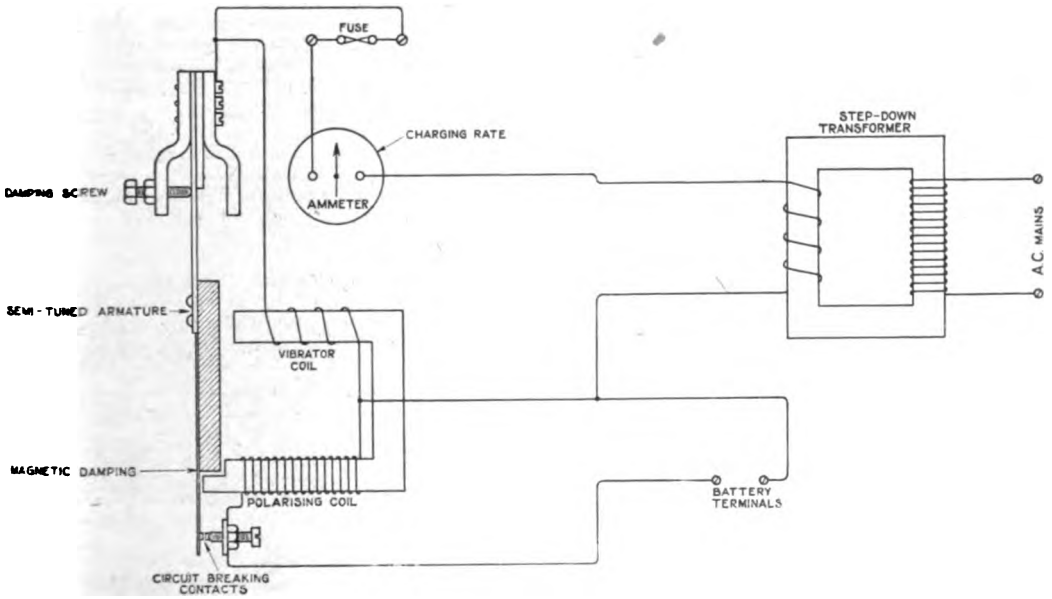


*Fig. 2. Circuit diagram showing the method of wiring.*

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## The South London Wireless and Scientific Club.*

Our meetings on Wednesday and Monday each week evidently "caught on," for our numbers have increased rapidly this last two or three weeks, and with the ever-increasing demand for expert practical and technical knowledge we hope that within a very short period to have created a new record.

The members have responded so well since our formation in November, 1921, that demonstrations, lectures, etc., have entirely eclipsed any idea that imagination may have credited us with, and we hope that we shall be able to further our activities of being such a live organisation, solely devoted to the amateur in South London.

Recently, our old friend, Mr. Walsh, gave us a very interesting lecture on "High Frequency," accompanied by practical demonstrations with a 10 in. spark coil, glass plate condensers, Oudin coils, etc., besides furnishing us with very interesting data regarding the construction formulæ for this type of wireless transmission, and to whom we must tender our very best thanks.

This lecture was followed by Mr. Wilkinson on "Cinematography," with special reference to kinematics, and this gentleman proved a most distinguished lecturer, as well as a very good linguist. Having dealt with the projection, manufacture, and taking of the cinematograph film, he then dealt with the theory of light rays, and altogether this was one of the best lectures we have as yet heard, and was certainly thoroughly appreciated by the members, and a vote of thanks was duly accorded.

Forthcoming events include every date up to July, and full details may be had of the Assistant Secretary, Mr. Ansell, 69, Larcom Street, S.E.17, as regards subscriptions, entrance fees, etc., or to the Headquarters, St. John's Institute, Larcom Street, S.E.17, where all meetings take place.

## Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A general meeting was held at the Leeds University on Friday, June 9th, Mr. A. M. Bage (Vice-President), taking the Chair at 8 p.m. The Chairman called upon Capt. F. A. Whitaker, R.E. (Vice-President), to deliver a lecture describing a six-valve cabinet set for reception on all wavelengths. Originally, Capt. Whitaker had hoped to embody a demonstration of telephony reception during the course of the evening's programme, but as Capt. Whitaker explained, he had been unable, owing to urgent business, to complete the necessary arrangements for transmission, etc.

Capt. Whitaker exhibited a complete receiver, entirely assembled in cabinet form at home. The set may be used for practically all wavelengths, the short wave and the long wave sets being complete separate units. A separate heterodyne is included in the cabinet for use, if necessary, on all wavelengths. The switching and mounting arrangements of the various inductances and capacities are unique; practically any circuit can be set up in a very few moments by the combination of switches, plugs, etc. If all valves are in use, the first three, of the E.S.2 type, amplify at radio frequency, these valves being coupled with either transformers, resistance-capacity or reactance-capacity couplings, according usually to the wavelength. Rectification is attained by means of the cumulative grid condenser and leak method with an "R" valve. Radio frequent currents from the separate heterodyne are introduced into the grid circuit of the rectifier with magnetic coupling, when receiving continuous wave signals. The rectified signals undergo two further magnifications at audio-frequency, before application to the telephone transformer, and so to the telephones or loud speaker. Elaborate precautions to guard against stray static fields have been taken, copper sheet being used extensively throughout the cabinet for shielding purposes. Separate filament and anode batteries are used for the H.F. side, the rectifier, the L.F. side and the heterodyne. Capt. Whitaker explained the function, construction, etc., of practically every component in the set from aerial to earth.

At the close of Capt. Whitaker's remarks, the Chairman opened a discussion, which proved very interesting and instructive. The performance of the set on the shorter waves was criticised particularly. After the discussion a vote of thanks was proposed to Capt. Whitaker, and was duly seconded and carried in the usual manner. The meeting then broke up to examine the very elegant apparatus on view. The set is undoubtedly one of the finest receivers existing in this country, both from the efficiency and workmanship points of view.

The proceedings terminated at 10 p.m.

## Kensington Wireless Society.*

A general meeting was held at 2, Penywern Road, on Thursday, June 1st, when Mr. Axten gave a lecture on "A Simple Low-Power C.W. and Telephony Transmitter."

The circuit used was of the "auto-jigger" type, the microphone being in shunt with a few turns of the coil, and the key in the grid lead.

The power supply was 110 volts A.C. from the mains, no step-up transformer being used, rectified by an ordinary receiving valve, the lecturer stating that good results both on C.W. and telephony were obtained over short distances using an "R" valve for the power valve.

The complete apparatus was mounted on a small panel, which was handed round for inspection.

The lecture caused some discussion, several members giving their experiences with this and kindred types of transmitters.

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After Mr. Axten had been accorded a hearty vote of thanks, the meeting was adjourned.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, S.W.10.

### Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

The series of elementary lectures arranged by this Society was most successfully inaugurated on Friday, June 9th, when Mr. J. Stanley, B.Sc., A.C.G.I., gave the first of his lectures on the "Elementary Theory of Wireless Telegraphy and Telephony."

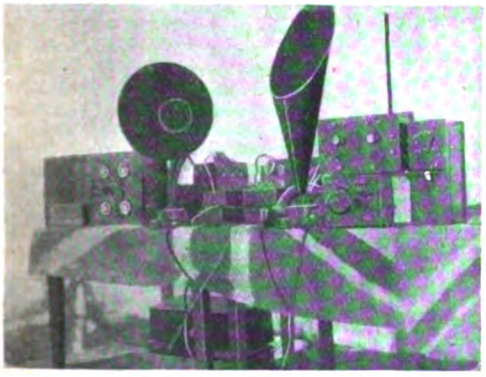
The lecturer confined himself to clearing the ground for his more advanced papers by going carefully over the fundamental electrical theory on which, of course, purely wireless work is based. He gave a brief outline of the electronic theory of matter, and by the use of interesting analogies gave useful and simple definitions of most of the electrical terms and units used in wireless work. Mr. Stanley then went on to the most important part of his lecture and dealt with the qualities of electric circuits known as "inductance" and "capacity" and gave a most lucid account of their nature and effects. He illustrated these terms by several interesting experiments and made these rather difficult conceptions quite clear to the uninitiated.

His lecture was followed throughout with great interest by those present, and at the conclusion a hearty and spontaneous vote of thanks was accorded him. Mr. Stanley will continue his lectures next Friday from the point reached on Friday last.

There was an excellent attendance at the lecture, 18 visitors being present in addition to the usual attendance of members. After the meeting six of the visitors signified their intention of joining the Society.

Enquiries regarding the series of lectures and demonstrations and as to membership of the Society will be welcomed by the Secretary, and he will be pleased to give any information to those interested.

### Hounslow and District Wireless Society.*



*Apparatus used at recent Hospital Fête demonstration.*

### The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

The 20th meeting of the present session was held on June 8th. On this occasion Mr. Flint gave a demonstration of spark-coil experiments. The lecturer performed many interesting experiments and explained the "whys and wherefores" of each one as he went along.

Mr. Flint also gave a short description of the construction of a spark coil, and the principle on which it operates.

On the termination of the lecture a hearty vote of thanks was passed.

Mr. Martin then gave a short description of the benefits of valve socket H.F. transformers as opposed to other types.

After the usual "Question and Answer" period the meeting terminated.

*Members of the Hounslow and District Wireless Society.*

### Croydon Wireless and Physical Society.*

A meeting of the above Society was held on Saturday evening, June 3rd, 1922, at the Central Polytechnic. At this meeting, a formal lecture had not been arranged, but members had been asked to bring portions of their own apparatus which could be used in conjunction with the Society's aerial.

Several members accordingly brought apparatus, upon which some very good results were obtained, spark and C.W. signals, and telephony being received during the course of the evening.

The formal business, which was transacted at the commencement of the meeting, included a motion that ladies should be admitted to membership of the Society, on the same conditions as gentlemen. This motion was opposed by several members, but, upon being put to the vote, was carried.

The next meeting of the Society will be held on Saturday, July 1st, and the Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley, will be pleased to hear from anyone interested in radio who is desirous of joining the Society.

### Paddington Wireless and Scientific Society.

Hon. Secretary, Mr. L. Bland-Flagg, 61, Burlington Road, Bayswater, W.2.

At the second General Meeting of the above Society, which was held in the Electrical Lecture Room of the Paddington Technical Institute on the evening of the first of June, the attendance was good.

On this auspicious occasion it was fitting that

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our President should address the meeting, and when called upon to do so, our President responded in a manner both able and full of interest, speaking of the enormous amount of good the Society could do, individually, collectively, and for society generally, and the great part practical men played in the investigation of scientific problems. This led our President to the most important passage of his address, namely, do not believe that anything is impossible, rather should you strive to make it possible.

A hearty vote of thanks was proposed and very ably responded to by our members for Mr. Cooke's words of encouragement, and for the interest he is taking in our work.

Dr. J. H. Vincent, Vice-President, then addressed the meeting, speaking of the good the Society could do for its members, and the members could do for the Society.

A short paper was then read by Mr. L. Bland-Flagg on Inductance and Capacity, after which Mr. A. Hoban spoke a few words of advice to the junior members on the selection of circuits when they came to assembling the apparatus they are making in the workshop.

A number of questions were asked which were answered in a manner which left nothing to be desired.

The Hon. Secretary then read over the minutes of the last meeting, and presented the accounts which showed a good balance in spite of the heavy expenditure of the preceding month.

We had with us one new member in the person of Mr. Marley, B.Sc., and at the suggestion of the Hon. Secretary, Mr. Marley was elected Treasurer.

The meeting closed at 9 o'clock, after a very interesting and enjoyable evening.

### Ilford and District Radio Society.

On Thursday, June 9th, the Society opened its second year with a lecture on "Broadcasting and its Reception." The meeting was well attended and a number of new members came forward.

The lecturer dealt with the subject in very simple terms in order that those who were new to W.T. would be able to follow.

The signals were traced, with exceedingly clear explanations, from the microphone of the transmitting station, through the ether to the aerial of the receiving station, and thence *via* various optional stages of amplification and detection, to the telephones.

During the course of the lecture speech and music were picked up from **2 FQ**, and made audible to the audience by means of a loud speaker.

Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society was held on June 7th, at the Headquarters at the Kingsland Assembly Rooms. A good attendance was recorded.

It has been decided to add to Rule 5 that Associate Members can now be admitted; also each member will be allowed to bring a friend at the meeting once in six weeks, which I think will add to the already popularity of the Society.

Mr. Freeman gave a short lecture on "Hints and Tips," which was greatly appreciated by all concerned.

A very enjoyable evening was brought to a close at 9.45. Buzzer practice will be given from 9 to 9.45 in future.

### Guildford and District Wireless Society.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

On Saturday, June 10th, by kind permission of H.M. Air Ministry, a party from the Guildford and District Wireless Society paid a very interesting and instructive visit to the London Terminal Aerodrome, Croydon. The party travelled to East Croydon by train, leaving Guildford at 12.50 p.m. All were in high spirits. The pass for admission was soon presented to the officials by Mr. F. A. Love, to whom the Society's best thanks are extended for his efforts in obtaining it, and the party found themselves under the command of a gentleman of ample proportions, bearing upon the breast of his blue jersey, L.T.A.27, who conducted them to the little house, from which the voice they had all heard here in Guildford on their own "sets" is transmitted. The wonderful working and operation of the whole station was explained at length by the chief operator, a very pleasant gentleman, who did not seem a bit upset at having to again explain that which he had doubtless explained to many other such parties. Unfortunately "atmospherics" were very bad, and listening in was a little disappointing, some speech, however, was heard. Suddenly a new interest was awakened when L.T.A.27 asked if the party would like to visit the hangars. For nearly an hour keen interest was centred on the machines that ply between England and the Continent. Alas! the visit was then over. The aforementioned gentleman, still in command, conducted them to the roadway, and they were gone. All the joys of the day were not yet over, tea had been arranged for in Croydon, and a right good tea it was, too, very kindly given by Ald. W. T. Patrick, J. P. (Chairman of the Society), and to him, after the "capacity" of the party had been satisfied, a very hearty vote of thanks was proposed, and needless to say was thoroughly supported.

On the whole the day was thoroughly enjoyed by all, and undoubtedly all were feeling much wiser on Sunday morning. The Society hope at an early date to be able to pay a visit to some other station in the neighbourhood.

The Secretary would be very pleased to hear from anyone who is interested in wireless or to introduce them to the Society's "set" which is open every Monday evening at 7 p.m., at 4ba, High Street, Guildford.

### Shrewsbury and District Radio Society.

At a meeting recently held, the following officers were elected:—

Chairman, Mr. T. Plummer, M.I.E.E., Supt. Engineer G.P.O., North Wales District; Vice-Chairman, Mr. A. E. White, B.Sc.; Hon. Secretary, Mr. W. Thomasson, 1, High Street, Shrewsbury; Hon. Treasurer, Mr. G. H. Greenberg; Committee, Dr. R. C. Salt, Messrs. C. L. Naylor and W. G. Tarrant.

Meetings at present will be held every month. The Secretary will be pleased to hear from those in the district who are interested in wireless and are desirous of joining the Society.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper only : Queries should be clear and concise.* (2) *Four questions is the maximum which will be accepted at a time.* (3) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* **(4) The Editor cannot undertake to reply to queries by post.** (5) *All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** (7) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

**"W.G." (Scarborough)** *asks if he should get* **PCGG** *and other telephony on a single-valve circuit.* (2) *For interpretation of* **FL's** *meteorological signals.* (3) *If time signals sent out by Moscow at 21.55 is G.M.T. or local time.*

(1) The set shown should give **PCGG** rather weakly. For enjoyable results H.F. amplification is desirable. (2) An explanation is given in the "Year-Book of Wireless Telegraphy, 1922." (3) See issue of April 22nd.

**"L.P.M.S." (Lye)** *asks* re *Fig.* 12, *page* 726, *February* 18*th issue.* (1) *If the circuit will work as well with a number of tappings taken off the A.T.I. to a rotary switch.* (2) *How the filament battery is wired up.* (3) *Windings for the A.T.I.* (4) *What is the range of the set.*

(1) Certainly. Some arrangement of this type or a slider to the coil is very desirable. (2) As in any two-valve circuit, we have shown recently, *e.g.*, Fig. 3. page 812, March 18th. (3) and (4) The range of the set of course depends on the size of coils. For a range of, say, 8,000 metres, coil might be 10″×7″ of No. 26 with a parallel condenser of 0·001 mfd.

**"F.C." (Madrid).**—(1) Your aerial of four wires in parallel from A to C will be very good if you raise the C end somewhat. It is undesirable to have the distant end so close to earth as you show it. (2) Either of the wires mentioned should be satisfactory. (3) The receiver will be all right if you put a condenser across the primary of the first inter-valve transformer. (4) About ¼ kW in the aerial. We cannot say what music you are likely to hear in Madrid. You should, of course, hear Eiffel telephonic programmes.

**"CONDENSER" (Malton)** *sends a circuit diagram and asks* (1) *For a criticism of it.* (2) *If it will receive* **PCGG, 2 MT, FL,** *on telephony.* (3) *Gauge of wire to use for winding honeycomb coils for wavelengths of* 300 *to* 30,000.

(1) There are some errors in your circuit as it stands. A similar type of circuit is shown on page 179 of the issue for May 6th and as this is given as the outcome of personal experience by Mr. Stephenson, the values have no doubt been found experimentally. (2) Yes. (3) You might use No. 28 D.C.C. for the smaller coils and 32 D.C.C. for the more bulky ones.

**"AAC & ESSES AITCH" (Falkirk)** *sends two specimens of wire which he proposes to use for the construction of a telephone transformer for* 120 *ohms Sullivan telephones and asks for windings.*

The wires are really too heavy for use on the primary. One is No. 32 S.S.C. and the other No. 36 S.S.C. Using the No. 36 you will require approximately 6 ozs. for the primary and with No. 32 as secondary you will need about 1½ ozs. This will make a very large transformer and consequently the core will need to be ½″ diameter × 4″ long.

**"A.W." (Harrogate)** *submits 5-valve amplifier circuit and asks for criticism of the H.F. transformers.*

You do not say for what wavelength your H.F. transformers are required. For your purpose, for wavelengths beyond about 1,200 metres, it is better to use the resistance capacity method, as transformers wound with many turns on the primary and secondary usually function as capacity couplers. We would suggest that if you use No. 38 wire and the 1½″ bobbin and wind about 35 turns in each connecting alternate slots in series you will have a useful transformer with an optimum wavelength of about 1,000 metres. See page 112, April 22nd issue, and lower portion of left-hand column on Page 133, April 29th issue.

**"R.G.S." (Fulham)** *asks* (1) *If it is possible to receive* **2 MT** *and* **PCGG** *on a frame aerial 3′ or 4′ in diameter.* (2) *For suitable circuit.* (3) *Which is the most efficient, the frame aerial, or one of four wires of about* 10′, *or one single wire of about* 25 *feet.* (4) *Whether a particular receiver is suitable for use on a small aerial.*

(1) Read carefully article on aerials in May 27th issue particularly the latter portion. (2) For circuit see page 199, June 25th, 1921, issue. (3) The 25′ aerial would probably be the most efficient provided it is in an upper story, but we strongly advise you to try and put up a few extra feet of wire and so obviate complications and many stages of amplification. (4) The receiver is a "Burndept Ultra III," and in our experience gives good signals on a small aerial such as you describe.

**"C.E.G.B." (Kensington).**—(1) Aerials should point in the direction of the propagation of waves in the case of the "L" type. With frames, their planes must be always in the direction of propagation. (2) and (3) Frames are quite unsuitable for transmission even over short distances as they do not provide for setting up any appreciable strains in the aether. Communication can of course be established between two frames over distances of a few feet by placing them parallel to one another. (4) Your frame aerial transmitting circuit is quite good as an oscillator but you would get the results you require, that is, communication over 300 yards.

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were you to use a small aerial of a few feet long in lieu of the frame.

**"J.R.McC." (Paisley)** *asks* (1) *Gauge of sample of wire.* (2) *Nature of insulation.* (3) *If it is suitable for winding telephone transformer for use with* 120 *ohm telephones in valve circuit.* (4) *Windings for telephone transformer using wire of sample submitted.*

(1) 34 S.W.G. (2) Single silk covered, although the covering has been somewhat damaged in unwinding. (3) The wire is scarcely suitable for telephone transformers as the primary would take up such a large amount of space. (4) You may try the following dimensions, open core 5" long × ⅝" diameter, primary wound on first up to a diameter of 2⅛" without insulation between layers. Secondary for operating 120 ohm telephones to consist of about 2 ounces of the same wire.

**"S.J.S." (Glasgow)** *asks* (1) *If any of wires submitted are suitable for winding intervalve H.F. transformers.* (2) *Number of turns of* 36 *D.S.C. wire required to wind slab coil on* 1½" *centre, tuning with four coils to* 200/8,000 *metres with* 0·01 *mfd. condenser.* (3) *Issue of "Wireless World" in which article on School Receiving set has appeared.* (4) *Value in microfarads of a milli microfarad.*

(1) All of the wires submitted are suitable for intervalve oscillation transformers. One single transformer wound with copper wire will not efficiently cover a wavelength range of 1,000 to 13,000 metres unless you intend to tune it. If the primary is to be tuned with a parallel condenser then wind the primary and secondary so that the coupling can be slightly loosened. If the primary is not to be tuned, wind primary and secondary over one another, giving the maximum coupling and for 1,000 to 1,700 metres use the shiny wire and put on about one sixth of an ounce for each winding, and for 1,500 to 3,000 metres use a quarter of an ounce for each. (2) A parallel condenser of 0·01 mfds. across your inductances will considerably reduce the efficiency. You should use a small condenser of air dielectric with a maximum value of 0·001 mfds. With this condenser wind your coils with (1) ¼" of single layer (not slab) for 200 to 300 metres. (2) ⅞" for 1,000 to 2,000. (3) 4" for 3,000 to 5,000 and (4) 10" for 7,000 to 8,000. As the larger coils are of awkward dimensions, you may try making them of the slab type but in this case we cannot give you actual data as the method of winding considerably varies the inductance obtained. The actual amount of wire will be less than with the single layer coils, when concentrated in the smaller space. (3) Page 389, September 17th, and page 465, October 29th, 1921, issues. (4) 0·001 mfd.

**"F. B. & Co." (Bromboro)** *asks* (1) *Whether his set is capable of receiving spark, C.W., and telephony, and if so, what range of wavelengths.* (2) *For inductance windings.* (3) *Whether set should be capable of receiving Dutch and Chelmsford concerts.* (4) *How can it be known when the set is oscillating.*

(1) From your diagram it is evident that the arrangement of the circuit is very well thought out and is capable of all classes of reception, the wavelength ranges depend primarily upon the windings of the H.F. intervalve transformers, but of course, if these are of the plug-in type, the range will depend upon your tuning inductances. The circuit is not the most efficient that can be adopted for the reception of telephony on wavelengths below 500 metres. (2) You do not give length of your inductance formers and you do not say exactly the wavelength range you require, but if you wind your 5" former for 5" along it with No. 26 D.C.C. wire, bringing out your five tappings at ½", 1", 2", 3½" and 5", the aerial circuit will be tunable on your two-wire aerial from 600 to 2,500 metres. The reaction coil may be wound on your 3½" former with 2" of winding of No. 36 S.C.C. with tapping at ½", ¾", 1" and 1½" and 2". (3) Suitable for Dutch concert, but you will need to make two smaller coils for 400 metre telephony reception and the precise values can easily be found by experiment. (4) It is very evident when the set is oscillating for if the reaction is very tightly coupled a shrill noise will be heard in the telephones and as the reaction is loosened a "breathing" noise can be heard, terminating in a click when oscillations cease. C.W. signals will be heard, spark signals will have a broken note and the set will seem particularly sensitive. When not reacting, no C.W. will be heard and the set will appear less sensitive and spark signals will be heard on their natural note.

**"S.J.H." (W.C.1)** *wishes to know* (1) *The names of the stations* **ABC, XYZ, GBA** *and* **GBB,** *whom he hears very clearly on his three-valve set.* (2) *Percentage superiority of duolateral coils over other types.* (3) *If H.F. amplification is as efficient on* 24,000 *metres as on shorter wavelengths, such as* 3,000 *metres.*

(1) See correspondence on page 238, of May 20th issue. (2) The system of winding is quite efficient. Other types of coils could be wound, having less self capacity but would be considerably more bulky. (3) H.F. amplification on long wavelengths is best accomplished by resistance capacity intervalve coupling and thus arranged is quite efficient.

**"L.A.W." (Birmingham)** *asks* (1) *If circuit submitted will give results.* (2) *What improvements he might make.* (3) *Whether a two-wire aerial* 30' *high and* 45' *long is suitable for crystal reception.* (4) *Whether low resistance telephones and telephone transformer might be used.*

(1) Yes, quite satisfactory. (2) No improvements with your present apparatus. (3) Yes. (4) Not recommended.

**"CAMLACHIE" (Millwall)** *has a crystal receiving outfit with which he gets very little success and asks for advice as to the probable cause of failure.*

Your drawing does not show exactly the way in which the instruments are connected together, but if correctly connected we see no reason why you should not at least hear ship and coast stations and Eiffel time signals and weather reports, and the experimental telephony transmissions by Marconi House. We do not think it possible for you to receive Moscow with a crystal receiver on so small an aerial. There would appear to be minor errors in the arrangement of your aerial and we would strongly advise you to read the Instructional Articles that are given in this journal, the previous ones being in the May 27th and June 10th issues.

**"W.G.W." (Fulham).**—Your list of components would appear to be quite suitable for building up a three-valve set, but we should advise to start with a receiver employing only one valve, and then having got that working satisfactorily, you may consider the addition of amplifiers and elaborate

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tuning circuits. We cannot advise you on the merits of the instruments produced by the various manufacturers. Explicit details for the making of a single valve set will be given shortly in the Instructional Articles.

"**FOURTH HOUSE**" **(London)** *asks the suitability of a specimen of wire for the construction of an aerial.*

The wire stated by you to be No. 18 phosphor bronze is, we believe, No. 16 S.W.G. copper. It will give quite good results, though, of course, be careful of kinks.

"**G.B.W.**" **(Sunderland)** *wishes to add one amplifying valve to single valve set.*

The addition of a low frequency amplifier will give the best results and circuits showing the methods of connecting up have frequently been given in *The Wireless World and Radio Review.* Connect the primary of a low frequency intervalve transformer to your telephone terminals and bridge this winding with a 0·002 mfd. condenser. Take the ends of the secondary to the grid of the second valve and to L.T.—Connect the filament in parallel with the filament of the existing valve. The plate of the second valve is connected to one of the telephone leads and the other lead to the H.T. + terminal of your panel.

"**MEGOHMS**" **(Snodland).**—Do not connect your variable condenser in series with lead to crystal but transfer it to the aerial circuit, connecting either between inductance and aerial lead for reception below 600 metres or in parallel across the inductance for longer wavelengths. The potentiometer is not essential when using a silicon detector. Connect the detector and telephones in series and join them across the leads from the inductance. It is impossible for us to say wavelength range without precise details of the construction of the coil.

"**RADIO**" **(Eastleigh)** *wishes to know how to incorporate a four-electrode valve in a special receiver marked "Type 2843" and manufactured by the Marconi Company of Canada.*

The receiver is one apparently embodying separate circuits for short and long wave reception and we do not see how the four-electrode valve with its several tuned inductances, transformers and condensers can be conveniently fitted to the set. Very little practical data is available at the moment on the construction of sets using the four-electrode valve. We would advise you to carefully study the circuits given on pages 201 and 202 of May 13th issue. The merits of the various circuits are not known outside the research laboratories of the producers of this type of valve.

"**E.C.S.**" **(High Barnet)** *asks (1) For the method of adding a note magnifier to his single valve set. (2) Number of turns of No. 28 D.C.C. wire required to give 250/600 metres on a former 3½" diameter. (3) location of experimental stations* **XYZ** *and* **ABC.** *(4) For constructional details of L.F. intervalve transformer.*

(1) As your telephone terminals are connected on the negative end of the H.T. battery you will need to either change them about or short circuit the telephone terminals and connect your intervalve transformer between the positive of the H.T. battery and the H.T. + terminal. The primary must be bridged with a 0·002 mfd. condenser. The remainder of the connections are as given to "**G.B.W.**" **(Sunderland).** (2) Precise number of turns depends upon dimensions of aerial. Try 30 to 35 turns in the aerial circuit and 40 turns of your No. 36 on a 3" diameter former for reaction coil. (3) See reply to "**S.J.H.**" **(W.C.).** (4) Make one of the type described in the first article of June 17th issue, winding primary and secondary with No. 46 S.S.C. wire and making secondary have twice the depth of winding as the primary.

"**M.N.**" **(Gosport)** *has difficulties with regard to the erection of an efficient aerial and consequently proposes to adopt three-valve H.F. amplification. He wishes to know (1) Which is the more efficient, resistance capacity, or transformer coupling. (2) If the 3½" × 4½" ebonite tubes he has are suitable for the construction of H.F. intervalve transformers. (3) If we would advise him to adopt the circuit shown in Fig. 3, page 705, February 4th issue. (4) Whether grid condenser and leak rectification is necessary on the last valve.*

(1) Transformer coupling gives the better results up to 2,500 metres and beyond this wavelength the resistance capacity method is usually more convenient. (2) With the tightly coupled transformer windings it is not advisable to attempt tuning with a variable condenser. Your tubes are of rather large diameter for the purpose, but may be satisfactory if your transformers are well spaced. Make primary and secondary windings of exactly the same number of turns insulated from one another with a single layer of empire cloth. Use 50 turns for each winding for 300 metres, 150 turns for 600 metres, 450 turns for 1,000 metres, 800 turns for 1,500 metres, and 1,300 turns for 2,000 metres. Make both windings in the same direction or take off grid and plate connections from the same end of the coil. (3) and (4) The figure referred to can be well recommended, arranging potentiometer grid control for the second and third valves. Try a "soft" valve for the rectifier with separate potentiometer control. The potentiometers you have out of Mark III tuners may be used satisfactorily.

"**H.G.W.**" **(Bow)** *wishes to know* (1) *and* (2) *If his set consisting of detector valve with reaction and note magnifier is suitable for the reception of the Dutch concert.* (3) *Why he has a difficulty in keeping his tuning constant during rain and* (4) *The source of telephony using call sign* **XYZ,** *which he states is stronger than* **2 MT.**

(1) and (2) Your circuit is in every way correct, and should give **PCGG** on a suitable aerial. (3) If your aerial is not well insulated it may be that the wet causes a partial earthing. Rain may actually run down your leading-in wire and make a thin stream of water to earth. Examine your leading-in insulator and study the points to be observed in aerial construction given in the article on Experimental Station Design, page 259, May 27th issue. (4) See reply to "**S.J.H.**" **(W.C.1).**

"**RADIO**" **(Barcelona)** *asks questions relating to the suitability of his coils for tuning to Paris and short wave signals.*

Your basket coils would appear to be quite suitable for the reception of Paris but it is not possible to say what wavelength they will give without knowing the dimensions of your aerial. For reaction effects it is only necessary to couple one coil out of each of the two circuits which in themselves may consist of many coils. Basket coils give very satisfactory results and can be classed among the most efficient of compact tuning coils. You would do well to



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make up independent sets of coils suitable for the various wavelengths. We suspect that your difficulties are not in your tuning coils but in your circuit arrangements.

**"G.E.T." (Enfield Highway).**—(1) Your circuit is quite correct excepting that you have omitted the condenser across the primary of the first intervalve transformer which should have a capacity 0·002 mfd. (2) CQ means "All Stations." (3) See page 292, June 3rd issue.

**"P.R.T." (Hemel Hempstead).**—Your aerial tuning coil should tune up to about 4,000 metres on a two-wire P.M.G. aerial with parallel condenser of maximum value 0·001 mfd. (2) The two-wire aerial is to be preferred. (3) So few turns of wire would be required to tune to 100 metres and the number would so critically depend upon the capacity of the aerial that it is quite impossible to advise you, whilst a brief test would soon give the data you require. (4) A pancake coil to tune to 1,000 metres would not consist of 10 times either the turns or length of wire that gives 100 metres. Wavelength varies as the square root of the inductance, multiplied by the added and self-capacity of the circuit. Thus if the capacity is great a few turns of wire produce a much greater wavelength change than if the multiplying factor representing the capacity is small. Moreover, the inductance of a pancake coil is not precisely proportional to either the turns or length of wire. With inductances it is always so very easy to try various amounts of wire and notice what stations they bring in.

**"RECRUIT" (Birmingham).**—The 10 extra feet added to your 70 ft. single wire aerial should prove an advantage provided the joint is well soldered as you propose. Light flexible wire should be quite suitable for lead-in and earth wires. A perusal of the article on Aerial Construction on page 259, May 27th, issue will acquaint you with all the desirable properties an aerial should possess.

**"G.E.D." (N.11.)** *is designing a single valve set and wishes to know* (1) *Sizes of A.T.I. and reaction coils for wavelengths* 100/3,000 *metres.* (2) *Suitability of* 0·001 *mfd. condenser for aerial circuit tuning.* (3) *For a book indicating how to calculate relationship between aerial and reaction coil windings.*

(1) For a reacting receiver it is not necessary to use Litzendraht wire, as any damping that this stranded wire may obviate could have been compensated for by increased reaction coupling. Of course, with non-reaction receiving sets it is a distinct advantage to wind the inductances with wire having low H.F. resistance. To cover the range of wavelengths it would be preferable to employ a number of interchangeable coils as it is difficult to make a circuit oscillate on short wavelengths with a large amount of wire electrically connected and yet not included in the oscillating circuit. Exact windings depend upon aerial dimensions and you cannot do better than to determine the windings by experiment. (2) Quite suitable as would be the smaller condenser out of the Mark III tuner, the capacity of which is about 0·0004 mfd. and not 0·0025 as you state. (3) Tuned reaction circuits in general may consist of the same number up to half as many again as the turns in the aerial circuit. See "Radio Experimenter's Handbook," by Philip R. Coursey, Wireless Press, Ltd.

**"T.R." (Preston).**—The first gauge wire of the samples you submit is No. 38 D.S.C., which is hardly fine enough for the construction of a telephone transformer of small dimensions. If you have sufficient of this wire you might wind five ounces of it on a core of soft iron wires 4½" long × ⅝" diameter for the primary and over this one ounce of No. 30 S.S.C. for the secondary. As you propose using a crystal detector, the use of a telephone transformer is unnecessary and not to be recommended and unless you intend to take up valve working later on we should advise you to go to the expense of having your telephones rewound to 4,000 ohms. (2) The maximum capacity of your condenser is about 0·0009 mfd. (3) Yes, certainly, though you do not need the 4-volt battery unless your crystal is carborundum and then you will also need a potentiometer. (4) For circuit see Fig. 3, page 60, April 8th issue, omitting the potentiometer and battery if not applicable.

**"A.A.W.G." (Walderslade)** *asks* (1) *The best method of connecting a battery to a crystal set, and what crystal to use.* (2) *Wavelength range of a set.* (3) *Method of connecting a primary coil to set.* (4) *What is a potentiometer.*

(1) In your set put the aerial to the slider and the condenser to the top of the coil and not vice versa as shown. See Fig. 5, page 124, April 22nd issue. (2) Up to about 4,000 metres. (3) The rearrangement should be as in diagram (Fig. 1).

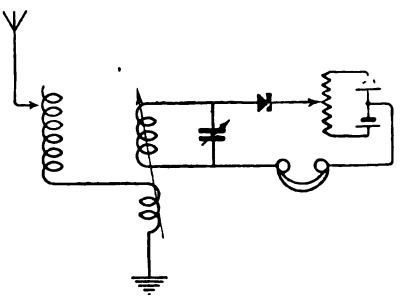

*Fig.* 1.

(4) A device for applying a variable potential on a crystal or other instrument. It consists of a resistance of about 300 ohms, fitted with a sliding contact and connected up as shown in the diagram.

**"REACTION" (Malvern)** *asks* (1) *Questions about a set sketched.* (2) *If the two wires of a twin aerial need be parallel.*

(1) The only way of getting sufficient variation of reaction with this arrangement would be to use basket coils for B and C. We cannot give dimensions as you do not state your wavelength requirements. The A.T.C. should be across both B and C. (2) No, but they should not be inclined at any great angle to each other.

**"R.N.B." (Camden Town)** *asks* (1) *For diagram of a single valve set suitable for telephony.* (2) *What he would be likely to hear.* (3) *If he could use honeycomb coils as basket coils, and if honeycomb coils would need a larger condenser.*

(1) A suitable circuit is shown in Fig. 1, page 335, June 10th issue. (2) Telephony in the London district; ships within about 100 miles and continental stations, such as the Eiffel Tower. (3) Honey-

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comb coils may be used if desired. If so, the condensers need not be larger.

"**C.E.P.**" **(Pontypridd)** *encloses a sketch of his receiver and asks* (1) *If the connections illustrated are O.K.* (2) *If not, what alterations are necessary to receive telephony.* (3) *If correct, what are the capabilities of the apparatus.* (4) *What telephones are suitable.*

(1) No. Connect as in diagram, Fig. 2. (2) As

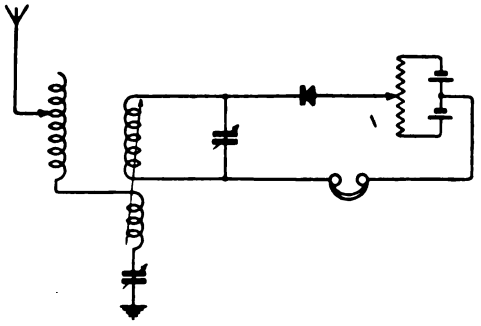

*Fig. 2.*

altered, the set will receive telephony from near-by stations. (3) Telephony range probably about 20 miles. (4) Any high resistance, resistance not less than 2,000 ohms.

"**NIB**" **(London)** *asks* (1) *If it is possible to get good results with a crystal and frame aerial 3 ft. square.* (2) *If a method of winding a frame aerial, which he sketches, is correct.* (3) *If results are impossible as suggested, what valve set we recommend.*

(1) Quite impossible unless you are in the immediate neighbourhood of a fairly high power transmitting set. (2) Method suggested is correct, provided of course the frame is made sufficiently strong mechanically. (3) This depends on results required. For London broadcasting one, or at most two valves with a certain amount of reaction should be sufficient. If greater distances are required three or four valves should be used with a frame set.

"**H.C.G.**" **(London)** *asks* (1) *Re Fig.* 13, *page* 727, *February* 18*th issue, if slab inductances would do.* (2) *Dimensions of coils to tune from* 180 *to* 30,000 *metres.*

(1) Yes. Honeycomb coils would be much preferable for the longer wavelengths. (2) Assuming this is done, about eight coils will be required, with a mean diameter of about 2", the number of turns would run from 40 for the lowest to 1,000 for the highest wavelengths.

"**V.R.**" **(Grappenhall)** *asks* (1) *For criticism of set.* (2) *What kind of telephones are suitable.* (3) *How to stop the sliders on the inductance coils cutting a ridge in the wire.*

(1) Set should give desired results, but would be better with an A.T.I. of about 4" diameter and No. 22 wire. (2) Any type with resistance not less than 2,000 ohms. (3) Carefully round the face of the plunger which rests on the wire, and do not use too great a tension on the controlling spring.

"**C.N.G.**" **(Pelton)** *asks* (1) *If his set is correctly wired up.* (2) *What improvements could be made.* (3) *If he added a similar valve and panel would he get the Dutch concerts.* (4) *Must the grid and the valve panel suit your valve, or will any type of valve do.*

(1) Yes. (2) The use of two tuning circuits loosely coupled, instead of a single circuit, would be a distinct advantage. (3) The addition of a second valve with H F. coupling should give you **PCGG**, but not very strongly. It is not necessary to have an additional filament resistance for the second valve. (4) The values of the grid leak and condenser depend upon each other. The type of valve, nature of the circuit, and the wavelength to be received. For average conditions and short to medium wavelengths use about 0·00005 to 0·0002 mfds.

"**RADIOLITE**" **(Merthyr Tydfyl)** *asks* (1) *If a five-valve amplifying set with a 6 ft. frame aerial, 20 ft. from the ground, will receive transatlantic high-power stations.* (2) *With a big frame aerial and two valves could he receive* **GLD**, *spark or Dutch concerts.*

(1) If the design of the set is good, transatlantic stations should be received under good conditions. (2) Very doubtful. You would get much better results with the use of an ordinary type long aerial.

"**G.P.B.**" **(Huddersfield)** *asks* (1) *Will telephony be distorted if the aerial runs for about 3 ft. parallel with a water-spout.* (2) *Is H.F. amplification better than L.F. for telephony.* (3) *What should be the capacities of the condenser across the A.T.I. and reaction.* (4) *Will his circuit receive* **PCGG** *and* **2 MT.**

(1) No. (2) Yes, unless the L.F. resistance capacity amplification is used. in which the preference is determined by the kind of results required. *i.e.*, L.F. for very loud signals, H.F. for making very weak signals audible. (3) 0·0005 mfd. across the A.T.I. We prefer to omit a condenser across the reaction coil, but a similar value can be used if desired. (4) **PCGG** possibly. **2 MT** doubtful, owing to the smaller propagation efficiency of the shorter wavelength now used.

"**IVY**" **(Birmingham).**—(1) *Refers to Circuit Fig.* 2, *page* 154, *April* 29*th issue, and asks whether it would be more efficient to make use of the potentiometer for grid control instead of grid condenser and leak.* (2) *If it is possible to obtain a calibration card for a Marconi type* 16 *receiver.* (3) *Wire for intervalve transformer* 500 *to* 5,000 *metres.*

(1) Yes, potentiometer control should be quite satisfactory and if the valve is at all "soft" you might obtain better results. (2) We do not think so, as you no doubt purchased the instrument second-hand, but we should imagine that you would have no difficulty in calibrating the set yourself from a standard wavemeter or putting it in the hands of a laboratory that undertakes wireless calibration work. (3) For an aperiodic transformer with optimum wavelength of 2,000 metres use No. 40 S.S.C. "Eureka" wire winding a single layer on an ebonite tube former 5" long × 2" diameter for primary and a similar length of winding for secondary with empire cloth insulation between windings.

"**S.G.**" **(Manchester)** *asks* (1) *For criticism of his three-valve set.* (2) *Should he use a series or parallel condenser on the A.T.I.* (3) *Data for his tuning coils.*

(1) The set appears O.K., but we should have expected a condenser across the primary of the H.F. transformer to improve results. You will

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require practically no filament resistance with R valves and 4 volts. Any inefficiency may be due to (*a*) too large values for the A.T.C.; (*b*) unsuitably adjusted reaction: (*c*) inefficiency of the H.F. transformer; (*d*) wrong values of grid leak and condenser. (2) If possible avoid using any parallel capacity on wavelengths not exceeding 1,500 metres. Series capacity may be used on the shorter wavelengths with advantage. (3) We do not recommend honeycombs for the comparatively short range you require. We suggest for the A.T.I. 7″×4″ of No 24 with slider or tapping at ½″, 1¼″, 3″ and 5″, with variable series condenser of 0·0015 mfds. For reaction coil 4″×3″ of No. 24, with two or three tappings.

**"E.H.C." (Ardingley College, Sussex)** *asks for criticism of enclosed diagram of set.*

The whole set is of so unusual a type that beyond saying that it transgresses all accepted rules and that we are sure that it will give no results we can give you little help. We suggest that you study any text-book dealing with valve circuits.

**"L.S." (Richmond).** *For a crystal set to receive broadcasting, asks* (1) *If a former 3½″×10″ wound with 22 S.W.G. be suitable.* (2) *Would a fixed condenser give satisfactory results, and of what capacity should it be.* (3) *The wavelength range.* (4) *Should he receive Paris time signals.*

(1) Yes. (2) 0·0002 mfd. in series with the A.T.I., and 0·002 mfd. in series with the telephones may be used. (3) Up to about 600 metres. (4) No; to do this you would require a much larger coil, say 10″×8″ wound with No. 22.

**"R.V." (Retford)** *asks how he can have a broken French R valve revacuated.*

We are afraid this cannot be done as the expense of re-exhausting is so nearly as great as that of the production of a new valve that manufacturers are not prepared to undertake this class of work.

**"RADIOSTAT" (Catford)** *asks* (1) *What was the wavelength and power used by Marconi House telephony station for transmissions re Carpentier-Lewis fight.* (2) *Will the Marconi House station be one of the future broadcasting stations.* (3) *If it is true the P.M.G. has removed all restrictions regarding amateur aerials and relinquished the inspection of stations.* (4) *In a single valve circuit where the H.T. is 60 volts and L.T. 4·5 volts, with the usual P.M.G. aerial, how far could the howls of the valve be heard on another single valve receiver.*

(1) Approximately 1½ kW input, 352 metres. (2) This is not yet settled. The question of location and running of a transmitting station will be decided by the P.M.G. in consultation with the manufacturers interested. (3) No. Some lessening of the aerial restrictions has been promised, but it is unlikely that the inspection right will be abandoned. It will possibly be more rigidly enforced, particularly with a view to the elimination of radiating receivers. (4) Quite impossible to say. One or two miles is quite a possible distance.

**"A.V.E." (Fulham)** *asks what stations he should get with a single valve set.*

This depends, of course, entirely on the type of set. With a good set you should obtain telephony from stations within 50 miles, ship stations and high power European Stations. You might even get American Stations under very favourable conditions.

**"A.J.H." (Harrow)** *asks if a wireless set would be a practicable proposition in a situation 30 yards from a Metropolitan Station and from telegraph wires.*

We think it probable that useful results would be obtained, particularly with the aerial at right angles to the wires. You may have some trouble from inductance, particularly if much L.F. amplification is used.

**"C.N." (Chesterfield)** *asks* (1) *for criticism of a crystal set.* (2) *Windings for the tuner.* (3) *Resistance for the telephones.* (4) *Criticism of a valve set.*

(1) Bornite to be used with zincite, not alone. (2) About 8″×6″ of No. 22. (3) At least 1,000 ohms unless a telephone transformer is used. (4) Condenser (a) 0·0005 mfds. A grid leak is useless without a condenser across it. Telephones to be shunted by a condenser. Circuit otherwise O.K.

**"C.C." (Chelmsford).**—(1) The simplest way to reduce your wavelength would be to use a fixed A.T.C. of about 0·0002 mfds. in series with your present coil, which should, however, tune down to 300 metres as it stands if the switching is correctly carried out. (2) Signals from Writtle should be strong, and from London audible, but quite weak.

**"M.R.N." (Oxford)** *has a single valve long range receiver, and asks* (1) *Should he be able to receive telephony.* (2) *In what issue was a two or three valve amplifier L.F. suitable for the above set described.*

(1) This set is most efficient at longer wavelengths than are used for most telephony. London telephony should be audible, but will probably be weak. (2) Such a set has been described in detail recently. For a suitable circuit see Fig. 1, page 811, March 18th issue.

**"L.W.T." (Sunninghill)** *encloses a sketch of his aerial and asks if it would be efficient when used with a single or two valve receiving set; if not, what alterations would be necessary.*

The arrangement suggested should give fairly good results. It would, however, be better to keep the whole aerial further away from the house if it could be managed. For instance you might erect a mast near the receiving room and carry the wire from there direct to the mast at the far end of the building. Either a twin or single wire aerial may be used. A two-valve set would meet with your requirements.

## SHARE MARKET REPORT

Prices as we go to press on June 16th, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 11 | 0 |
| ,, Preference .. .. | 2 | 7 | 6 |
| ,, Inter. Marine.. .. | 1 | 13 | 0 |
| ,, Canadian .. .. | | 11 | 4 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 15 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

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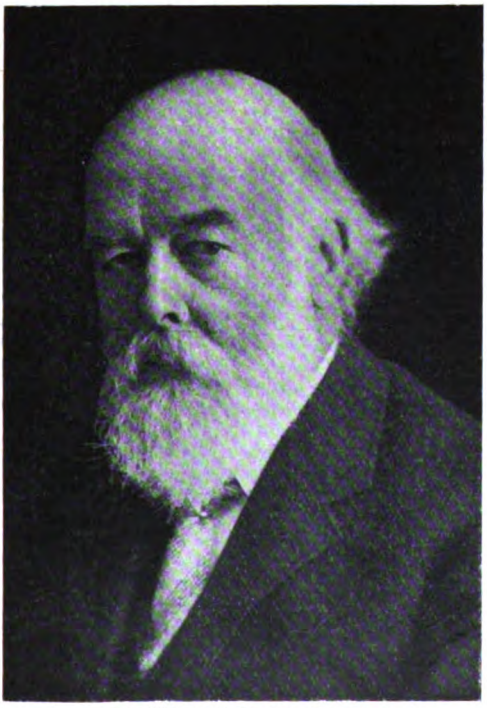
## Address to the Wireless Society of London*

By SIR OLIVER J. LODGE, F.R.S.

MR. PRESIDENT and Members of the Wireless Society—It is a pleasure to speak under the Presidency of Sir Henry Jackson, one of the very early pioneers in the application of Hertzian waves to actual telegraphy between ships, and one who has continued his interest in the subject to the present day. His naval position doubtless prevented full publication of the experiments made in 1895. Consequently, that early work is probably less well known than it ought to be, even by myself.

To a great application of this sort many have contributed; but nothing could have been done had it not been for the magnificent researches in pure science of the great physicists, James Clerk Maxwell and Heinrich Hertz. The present generation can hardly realise, I expect, the sensation caused by Clerk Maxwell's mathematical prediction of electric waves. He showed so far back as 1865 that electromagnetic waves were possible. No, I hardly think he showed that they were actually possible, he certainly did not show that we could generate them, but he showed that they existed and that they would have certain properties and gave their theory, the beginnings of their theory, and ultimately their more complete theory was dissected out from his work by Hertz. I do not think that in this country, at any rate, the name of Hertz is sufficiently well known, that is popularly known. He died very young in the thirties (of his age I mean), but not before he had done some very remarkable things. His chief discovery was the actual production of the electromagnetic waves in space, which was unknown in this country in 1888, and he not only displayed them experimentally, with the very inferior tools which were possible at that time, but he gave their theory in some considerable detail, after a study of Clerk Maxwell's work, and worked out those wave diagrams which you find depicted in wireless books, those waves that curl over the face of the country emitted by an oscillator at the centre or origin. The complete waves are more like those shown in Fig. 1, and all that is due to Hertz. That is how Hertz depicted them, but if you use an earth connection, instead of a complete vibrator at the origin, then you bisect the figure as indicated by the dotted line, the lower half being the image of the upper.



*Sir Oliver J. Lodge, F.R.S.*

All that is in Hertz's papers, and it holds good to-day. He dissected it out of Maxwell's equations. Maxwell showed us all these details. He did not know all that was in his equations, but he showed

*At a meeting of the Wireless Society of London, on the 14th June, 1922.

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that the rate of propagation of waves would be the reciprocal of the geometric mean of the two ethereal constants, the magnetic permeability and the dielectric coefficient of the ether of space.

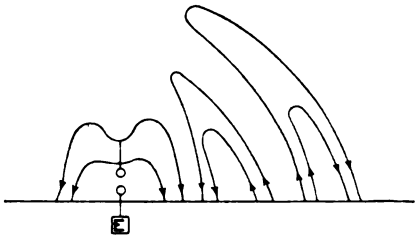

*Fig. 1. Electric Waves, showing effect of the Earth.*

I apologise to some of my audience for touching on very elementary things just now, but these two constants of the ether I must not lose an opportunity of emphasising in the presence of those who are working with the ether and to whom we look for the discoveries of the future. It is fashionable sometimes to disbelieve in the ether. Some of the newspapers think that Einstein abolished ether and that Eddington agrees with him. Eddington does agree with Einstein but Einstein does not think that he has abolished the ether. Einstein's theory does not say anything about the ether, but he has no thought or notion that the ether does not therefore exist. A thing does not cease to exist because you refrain from attending to it. Those who daily use the ether for signalling purposes can hardly disbelieve in its existence. I advise you to try and investigate its properties by all means. We actually use the ether a great deal more than simply for wireless signalling. We use it really in ordinary telegraphy and in telephony; you use it really when you are driving electric tramcars; you use it in every electric and magnetic experiment. Moreover you use it every time you look at anything, for it is through the ether that light comes and the eye is our one ethereal sense, only it is a sense organ which does not tell us anything about the ether but it tells us of all the things which agitate the ether and emit or modify the light which enters the eye. We learn about the things in the ether, not about the ether itself, but by means of the ether. That is an inference which is not at all obvious and the human race existed for I don't know how many thousand years without knowing anything about it.

Now, I say, the ether has two great constants which are defined electrically and magnetically. Thus, if you take two electric charges $e$ and $e'$ at a distance $r$ apart, the force of attraction or repulsion between them is the ordinary law $F = \frac{ee'}{r^2}$, but the dimensions of that equation, if I leave it like that, are all wrong. You have two electric charges multiplied together, and you don't know what they are, you divide by the square of the distance and get a force. There must be some constant whose dimensions will put the matter right. That is the constant which Faraday called $k$, and it is called $k$ to-day—Faraday's dielectric coefficient. We then get

$$F = \frac{ee'}{kr^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Faraday did not treat it as a property of the ether but treated it as the property of the substance, and measured the value of $k$ for different substances in consequence. In a vacuum it has some value, though we have no idea at present what that value is. The constant $k$ is unknown; all that we know are the relative values of $k$. Comparing the $k$ of different materials with the $k$ of vacuum we can say that in one substance the inductive capacity is measured by 3 or 6 or what not, but the true $k$ is unknown—it is the property of the ether.

Take then the similar magnetic equation. Take two magnetic poles ($m$, $m'$) and put them at distance $r$ apart. There will be an attractive or repulsive force according to the law, $F = \frac{mm'}{r^2}$, and again as you do not know the dimensions of magnetic poles you must introduce the constant that will put the dimensions right, *i.e.*,

$$F = \frac{mm'}{\mu r^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

That constant was named by Lord Kelvin the magnetic permeability, but again he treated it as relative to different substances—the magnetic permeability of iron having a high value and it may be a thousand times bigger than in an absolute vacuum. It is important to remember these magnetic quantities do not belong to matter, they belong to ether.

Matter interferes with light. Light comes through the ether not through matter. If there is matter in its path it is interfered with. It may be reflected, it may be absorbed, but it is never assisted. Light is transmitted by the ether, sound is not. Sound won't go through a vacuum, light will. That magnetic permeability constant then is the permeability of the ether of space, and is another constant of the ether. These two are the only two constants which we know the ether possesses, and we have not the remotest knowledge of the value of either, but Clerk Maxwell showed that if there are waves in space they will travel with a velocity $v$ equal to the reciprocal of the geometrical mean of these two constants, *i.e.*,

$$v = \frac{1}{\sqrt{k\mu}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

He made experiments to determine that velocity not by exciting waves, for he could not have done that, but by balancing the repulsion of two flat coils placed on the same axis, each being wound on a flat plate, Fig. 2. He balanced the repulsion of the coils by the attraction of the plates, the plates being electrified by connection to the terminals of the coils and the current being maintained through the coils. He took a measured current and measured the electric repulsion between the two coils, and balanced that against the electric attraction of the plates. The experiment is not by any means an easy one to carry out, but it is rather an elaborate one, and the above is merely the barest outline of it. It gave not the values of $k$ or of $\mu$, but the product $k\mu$, since $k$ came into the electric attraction of the plates, and $\mu$ came into the magnetic repulsion of the coils. When he had balanced the two, from the dimensions he

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determined $k\mu$ and found it to be the reciprocal of the square of the velocity of light. The results came out within the limits of experimental error; and the electromagnetic theory of light was born.

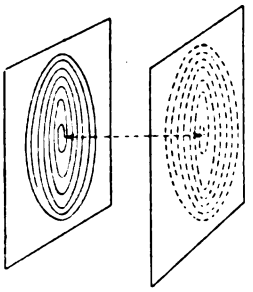

*Fig. 2. Maxwell's experiment for the determination of the product $k\mu$.*

You see the point: If they were electromagnetic waves they would travel at that speed, and so indirectly by measuring this product $k\mu$ in that experiment in which no light was used (except to see the instruments) and obtaining the velocity of light, showed that light was composed of exactly those particular waves, and that light was an electromagnetic phenomenon. The nature of light up to that time had not been known and I must say that his theory was not accepted straight away, and other theories continued for many years. Lord Kelvin, for instance, as one of the great leaders of science, did not accept Maxwell's theory until the year 1888. Maxwell's theory was born in 1865. It was well known to me in 1875, but there was a good deal of conservative feeling about the elastic theory of light—the ether being the light. Many ingenious mechanical theories were developed in the early part of the last century by Faraday and other great men, but they would not work, the more you went into them the more they would not work. The only theory that worked is Maxwell's, since light is not a mechanical thing at all.

So I say the electromagnetic theory of light was born then. No one knew how to produce waves except by the ordinary methods of producing light. But echoes of Maxwell's discovery ran about among the young students of these days. Fleming and I, in the Chemical Laboratories at South Kensington, had many talks on the subject in the 70's of last century. We both of us made a serious study of Maxwell, I partly during a stay at Heidelberg and he more personally at Cambridge. I constructed models illustrative of Maxwell's theory, and I for one determined to devote myself to the experimental production of such waves, if any method could be devised. Later in the '80's, I discussed various methods with my great friend G. F. Fitzgerald of Dublin, whose acquaintance I had made during a visit of the British Association to that City. And in due time—though at first he was sceptical about the possibility of producing them, (he read a paper on the "Impossibility" of producing them, but struck out the "im" afterwards) –Mr. Fitzgerald made the suggestion which ultimately in other hands proved successful.

I would like to call your attention to that, because I feel that the present generation which is very active in the practical application of these things and in the details which have grown up in recent years is naturally not so well acquainted with the ancient history of the subject as those who have lived through it, and so it is apt to be forgotten what a lot was done in those early days. Fitzgerald, in 1883, gave the amount of energy that could be radiated by an alternating current. You see all radio generators are really alternators, or oscillators, and because they emit waves it follows that continuous oscillators emit waves. This title of Fitzgerald's paper is: "On the energy losses by radiation from alternating currents."

Take an alternating current represented by $I = I_0 \cos \frac{pt}{T}$. You recognise that as an alternating current with a period $T$ and amplitude $I_0$. Now if you have an alternator producing that current it must radiate some energy. Fitzgerald calculates how much energy it radiates per second. He takes the case of a circular coil like a frame aerial connected with an alternating current, then the energy radiated per second $= (\pi a^2 I_0)^2 \frac{8\pi^4\mu}{3T^4v^3}$. That is simply the area of the coil multiplied by the current amplitude and the whole squared and multiplied by $\frac{8\pi^4\mu}{3T^4v^3}$ where $v$ = velocity of light and $T$ = the period of the oscillations, $a$ = the radius of the coil and $\mu$ = the permeability.

Since you do not know what $\mu$ is, you call it unity, and so you are expressing it magnetically, while if you are working in electrostatic units you call $k$ unity. It is the best we can do for the present, and I hope that some of you will find out what these values really are.

Returning to the expression for the energy radiated per second, the important part lies in the denominator in which the frequency is raised to the fourth power, *i.e.*, the radiated energy will be inversely as the fourth power of the wavelength. I might write that expression thus:

$$\text{Energy radiated} = (\pi a^2 I_0)^2 \cdot \frac{8\pi^4\mu v}{3\lambda^4} \quad . \quad . \quad (4)$$

That is to say, the radiated energy is inversely as the fourth power wavelength, *i.e.*, the longer the wave the less is the radiating power of an alternator, or the slower the frequency the less the radiation. All that was developed in 1883, and it applies to this day both to the alternator and to the Hertz vibrator, and it is encouraging to amateurs who are limited to short waves that the radiation from a short wave radiator is really more powerful than from a bigger one. The reason for that comes out very well from Hertz's method of dealing with the matter, because he showed in these wave diagram, which I have given above (Fig. 1) that the wave does not start actually from the oscillator, but a quarter of a wavelength away. Now consider the case of an ordinary commercial alternator or even an alternator with a frequency of a thousand per second, the wavelength is nearly 200 miles, a quarter of that is 50 miles, so if I had an alternator in this room with a frequency of a thousand per second what loss of energy will there be? Not much, because the radiation does not really start

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until 50 miles away, and 50 miles away the magnetic effect of that alternator is not noticeable. Hence for practical purposes there is no radiation from an oscillator of ordinary frequency.

This is rather analogous to Stokes' theory about a vibrating fan. Everyone knows that a tuning fork emits a musical note or a reed does if it is vibrating fast enough. Everyone also knows that a lady's fan does not, even if it is very hot. That is because it is not moving fast enough to create waves. There is a critical speed, which Sir George Stokes worked out, which is necessary before the air is condensed or rarefied. If you work it at any low speed the air curls round the blade, and is not rarefied to any appreciable extent. Now it is something the same with an ordinary alternator. Your present commercial alternator does not emit waves because its frequency is too low. If you raise it from a thousand per second to a million per second then you get some radiation and all the vibrations that we use in wireless are of the order of millions per second, as you know. But, if instead of millions a second you use a thousand millions a second the waves will be stronger still; the higher the frequency the better

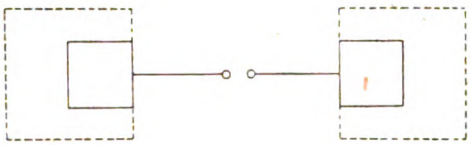

*Fig. 3. Inside square: ordinary Hertz Oscillator. Dotted square: enlarged Hertz Oscillator.*

the radiation, the radiation being proportional to the fourth power of the frequency. The radiation intensity of an ordinary Hertz vibrator such as we used to work with, excited by a coil (Fig. 3) is of extraordinary intensity, and when we used to work it out in the old days it came to about 100 H.P., from an ordinary radiator. If you make the radiator bigger the radiation is no stronger. If you make it bigger as shown dotted in the Fig., you get more energy to radiate, but you also give it a greater capacity. Of course, there is more electricity accumulated, and so you might expect to get more radiation, and you get more energy in the spark, but you get no more radiation because the wavelength is increased and so the radiation intensity is kept down.

It is rather like the radiation which you get from a hot body; the same law holds in that instance and, indeed, for a very good reason, for the radiation from a hot body is the excitation of waves in the ether, and the same theory holds. Contemplate the effect of frequency in this case—*i.e.*, the temperature as it is called in the world of heat. If you double the absolute temperature you more than double the radiation. You make it 16 times, *i.e.*, $2^4$. The radiating power of the hot body depends on the fourth power of the temperature; that is why the sun is such a prodigious radiator, although it is about 90,000,000 miles away. A few days ago it was exceedingly hot because of this terrific temperature. Every square inch of the surface the sun radiates 16 times as much power as the electric arc, and it is therefore adapted to distributing energy into space in the most efficient manner. But, you may say, why then do we use long waves for getting great distances in radio signalling? Well, these short waves, although they start with great energy, are easily mopped up if there is any obstruction in the way. A short wave gives hundreds of opportunities for being mopped up. That is why light is so easily stopped. The waves are so short and the frequency so high that in an $\frac{1}{8}$th of an inch of space there are thousands of oscillations which have no chance of getting through if each oscillation is wiped out to the smallest degree. Hence, a very thin obstacle will stop light and a much thinner obstacle will stop ultra-violet light, but when you come to the long waves of what we call heat they get through much more readily, and when you come to the longest waves of wireless telegraphy they can go through all sorts of things, and the longer they are the more they can get through. Hence, long waves are useful and necessary for travelling great distances across obstacles and through the atmosphere and round the earth where they may be reflected by the upper Heaviside layer.

At that time, however, the whole subject of electrical oscillations was unexplored, and by many prominent men it was disbelieved. It is true that Kelvin had given the theory of electrical oscillations, quite apart from any idea of waves, as early as 1853, in a very remarkable and still interesting paper on "Transient Currents," to which I would like to call your attention. It is quite a readable paper, as you can see for yourself unless you are bothered with the antique terms, but the whole idea of electric inertia or what Maxwell calls self-induction, but which Kelvin called "Electrodynamic-Capacity," was new and confused, and a great deal of experimental work had to be done to bring home the fact of electrical oscillations in a circuit containing capacity and self-induction. One of the methods for displaying the oscillatory character of a discharge was to take photographs of a spark on a revolving plate. This was done by C. V. Boys and several others (see, for example, Fig. 4).

By this method I determined to make a metrical determination of oscillation frequency, using

*Fig. 4. Photograph of oscillatory spark taken on a revolving plate.*

absolute measure, and so determining afresh the product of the two ethereal constants or the velocity $v$, but I have not time to describe that in detail now I entered into collaboration with Sir Richard

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Glazebrook, who at that time was Custodian of the British Association Electrical Standards in the Cavendish Laboratory at Cambridge, and with my assistant, Mr. E. E. Robinson, we took up our abode in Cambridge and worked in the Cavendish Laboratory for many weeks, and ultimately made a determination of velocity by means of an oscillatory discharge by a condenser through a known accurately determined self-induction.

The condenser was a large air condenser with multiple plates of known area and known distance apart, and the coil was a special coil of about 4 henries—or "secohms" as they were then called—the self-induction of which was determined by Glazebrook in absolute measure with extreme accuracy.

Laying off a length to represent the magnetic measure of self-induction, and another length in the opposite direction to represent the measure of electrical capacity, constructing a semicircle on these two lengths, and erecting a perpendicular to meet it, you obtain a radius which, employed as the spoke of a wheel revolving at the determined frequency, would roll along with a velocity "$v$," that is to say, with the velocity of Light. The frequency was determined by discharging the condenser through the coil, and photographing the spark on a plate which was kept revolving at a steady and known speed by a small turbine, controlled by observation of a stroboscopic disc through the jaws of a vibrating fork, which was carefully timed in absolute measure by a chronometer.

The whole investigation was published in the Stokes Memorial Volume, in 1899, published by the Cambridge University Philosophical Society, but that volume is rather buried, and I do not think it is well known.

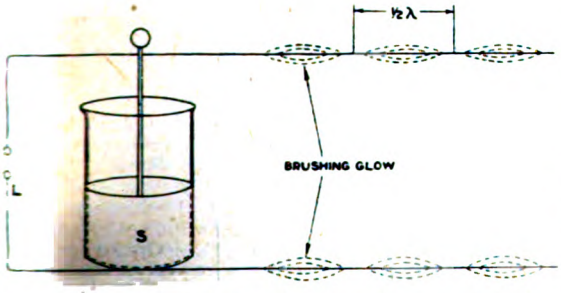


*Fig. 5.* ***Lodge's experiment*** *on the production of waves on parallel wires.*

The problem now was to convert these oscillations into waves or to demonstrate what Fitzgerald had insisted on, that they produced waves all the time. I succeeded in displaying these waves running along wires, by taking a Leyden jar and discharging it in the manner indicated in Fig. 5, with a couple of wires, one from each coating, running for some distance. I knew that the waves would run along the wires, at any rate along thin copper wires, at the same rate as they travelled through space. Consequently, by attaching long wires to an ordinary Leyden jar circuit of known dimensions I knew what the length of these waves ought to be. By that means I was able to demonstrate the waves, and in the dark the wire glowed at intervals. When the spark was produced the oscillations were set up and they splashed along these wires giving short glows interrupted by dark spaces. That was not the only method of displaying the effects, but it was one convenient method. By a reflection at the far end the waves on the wires were converted into stationary waves and the distance between the glows was half a wavelength, and so the wavelengths could be measured and compared with theory. They came out correctly. That was what I showed at the Physical Society of London, but it was not properly published.

The arrangement of the jars and wires became well known afterwards under the name of Lecher, who, in Germany, made a large number of excellent experiments in this direction, using vacuum tubes as his detector, as, indeed, had also been done by Dr. Drakoulis in my laboratory at Liverpool.

That arrangement was described at Bath with experiments of that kind, in the year 1888. But Fitzgerald who was President of Section A of the British Association that year, called attention to the publication that had just been made the month before by Hertz. He had got waves in the same way with nodes and loops, but in space, not running along wires at all, by opening out the coatings of the Leyden jar into two capacity areas, so that the electrostatic field extended into space as well as the magnetic field, thus giving the necessary conditions for generating electro-magnetic waves of considerable intensity—in fact of very remarkable intensity, so strong that they could excite little sparks in conductors in the neighbourhood. This fact that they were strong enough to produce sparks was surprising, but it was the fact which enabled the waves to be discovered at that time; a brilliant series of experiments were made upon them by Hertz in spite of the troublesome and capricious nature of his means of detection.

The paper in which I first published the account of the experiments on these waves, and with that diagram (Fig. 5), was published in the *Philosophical Magazine* for August, 1888, but it is buried under the title of the "Theory of the Lightning Conductor." I would like to draw your attention to it because it is buried, and it shows the historical kind of feeling about these waves that was going on at that time.

It is interesting to see how short it is practically possible to make waves of this kind. The wavelength was written down as:—

$$\lambda = 2\pi \sqrt{\frac{S}{k} \cdot \frac{L}{\mu}} \quad . \quad . \quad . \quad . \quad (6)$$

where $\lambda$ = wavelength
$S$ = capacity of the Leyden jar
and $L$ = inductance of the discharge loop.

That formula which holds to this day and was the best expression for wavelength known in 1888, shows how short it is possible to make waves of this kind. I reckoned that I might be able to get them 20 or 30 centimetres long, corresponding to a thousand million alternations per second, but the difficulty was to detect them. It might be possible to get them shorter, which Hertz did, but how could they be detected. No doubt they could be detected with the greatest ease by using the wave-

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lengths of light, and I consider that glow-worms and phosphorescent creatures have learnt how to accomplish this direct production of very short waves.

Since writing the above I have seen in *Wiedemann's Annalen* an article by Dr. Hertz where he establishes the existence of ether waves in the same way but in free space. The whole subject of electric radiation seems to be working itself out splendidly. I should like to say more about that luminosity and vision, but there is hardly time for that in this lecture.

At any rate the early researches of Branly and the discovery of the coherer followed; but the surprising thing that Hertz found was that these waves had energy enough to produce sparks. Imagine *light* so intense that when it fell upon anything it produced sparks, that was the equivalent of what he got. The radiation was at the rate of 100 H.P. while it lasted.

The discovery of the coherer followed, and then things were much better, and by means of the coherer I continued spasmodic experimenting in the intervals of teaching, and at the lamented too early death of Hertz I described my experiments at the Royal Institution in 1894 as a sort of memorial to Hertz, calling the lecture "The Work of Hertz," though I ought to have called it "The Work of Hertz and His Successors," for a number of new results were shown in that lecture. Later, in the same year, 1894, at the British Association meeting at Oxford, I demonstrated that signals could be sent by this means, using a Thomson marine galvanometer for short and long signals; as has been recorded by Silvanus-Thompson, and as known to many others who were present. Alexander Muirhead then began to work at what subsequently became known as wireless telegraphy. Professor Righi at Bologna also devoted himself to the extension of Hertzian experiments, and your President, Sir Henry Jackson, began an attempt to apply the method in some form to ships at sea. Then in 1896 came Mr. Marconi to England, full of energy and enthusiasm and possessing the ability to interest officials and financial magnates, and wireless telegraphy proper entered on its tumultuous career.

Tuning and selectivity, so that stations could be discriminated from each other, and one tuned in while others were tuned out was secured by my patent of 1897. Crystal detectors gradually became employed instead of the more troublesome coherer, and then came the era of the valve wherein electrons were first harnessed to the service of man. And after that most of you know more about the subject than I do, and certainly your past President, Mr. Campbell Swinton, knows a great deal more.

I have gone over the early past history chiefly in order to recall to your attention the extraordinarily brilliant work of Clerk Maxwell. It was not of a kind to get into the newspapers or to be understandable by the people. But in the students of those days—I mean the students of mathematical physics—it aroused the utmost enthusiasm; and it is well that this mighty work in pure science should not be forgotten and overwhelmed in the mass of practical detail and exuberant invention, which is a characteristic of the additional developments in our own day. "All can raise the flower now, for all have got the seed." But it is well occasionally to think of what we owe to the sowing of that seed, as sprinkled in algebraical symbols on the pages of Clerk Maxwell's papers and incorporated, some of them, in his great book.

Since that time Sir Joseph Larmor has shown that Clerk Maxwell's equations contain the whole theory of radiation, and the relation between electric charge and the ether of space. He has also shown that radiation is always excited to a known extent whenever an electron is accelerated, and that without electric acceleration there is no radiation. I must just give Larmor's expression for the radiation of energy because it is very fundamental. It is:—

$$W = \frac{2}{3} \cdot \frac{e^2}{c} \dot{u}^2 \quad . \quad . \quad . \quad . \quad . \quad (7)$$

This gives the energy radiated per second from an accelerated electron where $e$ is the charge of the electron; $c$ is the velocity of light; $\dot{u}$ is the acceleration.

Why is that expression so important. It is because it is exceedingly general and comprehensive. Radiation of so many kinds is known—X-rays, wireless telegraphy, light, radiant heat—all these obey that law—there is no radiation if an electron is not accelerated. There are three possible states: an electric charge stationary is one of them, an electric charge in unchanging motion is another, an electric charge in changing motion, or acceleration is another. You have the three great departments of the science. Static, kinetic, oscillatory. In the first the charge is at rest, *i.e.*, ordinary static electricity. In the second the charge is in motion—steady motion—that is magnetism. Directly a charge is put in motion you get magnetic lines surrounding the path of the charge. That is all that magnetism is. You don't get any magnetism unless there is a moving charge. In the third, the charge is accelerated, and that is light, because you see in any oscillation there is acceleration. The connections between these three groups are indicated in the table:—

| Charge at Rest | Charge in Motion | Charge in Accelerated Motion |
|---|---|---|
| Static | Kinetic | Oscillatory |
| Electricity | Magnetism | Optics |

Wherever you have acceleration, and therefore whenever you have oscillation, you must get radiation to an amount which depends upon the frequency in the way I have been explaining, and the amount of energy radiated depends upon the square of the acceleration—*i.e.*, upon $\dot{u}^2$ ($\dot{u}$ being the first time differential of the velocity $u$). If an electron is moving steadily it does not radiate at all, it does not lose any energy—a magnet loses no energy. When its velocity changes, it radiates energy depending on the square of the acceleration.

The only step beyond that is the detection by Prof. Planck, of Berlin, of the quantum. We all hear about the quantum, we do not hear so much about the quantum as we do of Einstein, but it is, nevertheless, a very important thing in physics. It is that curious and unexpected phenomenon

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which prevents radiation of energy below a certain amount and causes it to be emitted in packets or bundles in a numerable manner—by which I mean that the packets can be counted—but that no fraction of a packet can be got. It is rather like buying postage stamps. You may buy any number but not half a stamp, or it is like coins of the lowest denomination, you can pay with any number of them but you cannot have fractions, so that it seems that energy was given to us in quantum units or packets, but no fractions, and if you could not have a whole quantum you could not have anything. If an object cannot emit a whole quantum of energy it does not lose any energy at all.

The quantum thus brilliantly discovered in physics is a fundamental constant of Nature, and we now see that it must depend somehow on the properties of the atom. Although a great deal was said in the other direction I admit there is no discontinuity in the ether or in energy or in time, but there is discontinuity in a group of electrons, and in the atoms which are built of electrons, and, accordingly, in atomic theory the quantum is of fundamental importance, and in the hands of Prof. Böhr, of Copenhagen, has begun to solve the secret of atomic constitution. Prof. Böhr's work is well known to those who know it—(*laughter*)—and too elaborate for anyone else. But it is the needed supplement to Larmor's theory, and the quantum may be said to be the first vital and fundamental discovery in the region of electro-magnetism since Clerk Maxwell, for all the rest of the theory of electricity, magnificent and extensive as it is, may be regarded as a legitimate development of those astonishing equations which contain within themselves a great part of the secret of the ether, except in so far as it is modified and sophisticated by the presence of the discontinuities of matter.

And yet there are signs that even the quantum can be got out of these old equations too. Attempts in that direction are very recent—too recent to be properly referred to. But I must just refer to a paper by Prof. Whittaker, of Edinburgh, read before the Edinburgh Royal Society last month (May, 1922), together with an introduction and a sequel to it by Sir Alfred Ewing.

The fact that required explanation was that an electron impinging on an atom gave it no energy unless it attained a certain critical velocity, that if it had this critical velocity it delivered up to the atom a certain packet of energy—a quantum, or it might be two or three quanta but no fractions—and that if it had a velocity greater than that critical velocity it delivered up no more but retained the residue.

Furthermore, that an atom so struck emitted this quantum of radiation at a definite frequency, determined by the energy on the impinging electron, and then settled down again into its own steady condition.

Moreover, that if radiation of this frequency fell upon an atom an electron was expelled with an energy precisely corresponding to that frequency; the relation between the energy and the frequency being always definitely determined by the quantum.

It is rather ambitious to refer to this thing now, but you will, I expect, hear more about it because it is an important thing, and I think it will help you if I indicate something of what it is. I was going to trouble you with the equation, but I won't do that, I will just illustrate how an electron striking an atom might refrain from giving it any energy at all unless it gave it a whole quantum and that it will not give it more than a quantum, but will retain the rest. I am going to take a ring of perfectly conducting material, (Fig. 6). The little difficulty—if it can be called a difficulty—of following this experiment is because we are not accustomed to dealing with perfectly conducting materials, but some of you may know that Kammerlingh Onnes in Leyden cooled a lead ring down to nearly absolute zero by means of liquid helium—he cooled it down to within two or three degrees of zero—and the lead became perfectly conducting, so that if you excited a current in that ring, such as you might do by snatching a magnet out of it, that current would continue ordinarily for a fraction

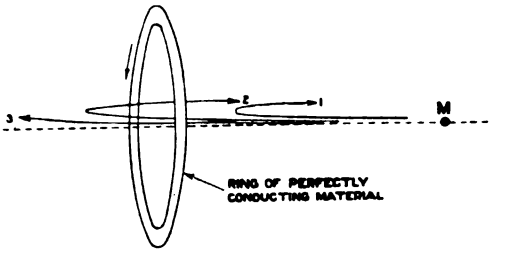


*Fig. 6. Diagram illustrative of energy quantum being given to perfectly conducting ring by a moving magnetic pole.*

of a second only, but with the conductivity so perfect there is nothing to stop the current, there was no resistance, so the current simply went on, it was like a flywheel. In Onne's experiments it died out ultimately—it is not going now—but it did not die out in a fraction of a second, and some trace of it lasted a fortnight afterwards, while it only died down to half its value in four days. Theoretically, if there was no resistance at all it would never stop. As Lord Rayleigh said four days was a very good approach to infinity. (*Laughter.*) It was a very interesting experiment. You could see the current was in the ring as it deflected a magnetic needle like a galvanometer.

As a matter of fact we are quite used to these currents, but they are generally of molecular nature, as in a magnet where they flow in the interstices of the atom since there is nothing to stop them.

It is like a planet and the sun. What makes the earth go round the sun? Nothing—there is nothing to stop it. Things in Nature do not want propulsion, they want guidance, deflection, they look after the rest. We are all travelling round the sun at the rate of about 19 miles a second. What is driving us? People think it is because they are attached to the earth, but they are not. I am quite loose, I am going round the sun on my own, there is nothing to stop me, and that is what we commonly find in nature—things just going on. We are each of us like little planets circulating once a year round the sun and turning on our axis in 24 hours. Your head is up now, in 12 hours it will



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be down. We are all doing the proper things on our own—a planet need not be a big thing—and so these electrons are just carrying on and in those experiments they were travelling round and round the ring. Now if you take a magnetic pole (the difficulty of this experiment is that you cannot get one magnetic pole without the other, that is a weak point, but you can imagine a magnetic pole) there is the ring with no current in it, and take the magnetic pole from any distance and bring it up to the ring. As it comes nearer to the ring it induces a current in the ring; that current induced by the approaching magnetic pole repels the pole. It is like propelling the pole as it were against an elastic coil. If you let it go it would drive it back again. If then you shoot at that ring a magnetic pole M (Fig. 6) from a long way off, it will follow a path shown by the arrow (1). It would put some energy into the ring as it approaches, but that energy will be transferred back to the pole as it recedes, and it will go back with the velocity with which it came, retaining its energy and leaving none in the ring. It put energy into the ring, but took it back as it receded. If it is fired at the ring with more energy, and it gets as far as (2), it will still go back. Just for a moment you may think it should be propelled the other way, but that is not so, since the repulsive force is in the same direction. In order to retain any of its original motion it must travel with sufficient speed to get right away out of the range of the ring altogether (3), if it does that it will not wipe out the current generated. If it does that it will have some energy left to go on, and it will have left a quantum of energy in that ring. It will retain the rest. The energy delivered to the ring is

$$\tfrac{1}{2} m (u^2 - v^2) = h\nu \quad - - - - - - \quad (8)$$

where $m$ = the mass, $u$ = the initial velocity and $v$ = the final velocity after passing the ring.

If it starts with the velocity $u$ and leaves with the velocity $v$, it retains the rest of the energy, and only delivers up that to the ring the amount given by the above expression which is commonly written as $h\nu$. Beyond this rough outline, the matter becomes rather too difficult at any rate to explain in less than a separate lecture. But on somewhat those lines the quantum can be explained in terms of Maxwell's equations, and it is interesting to me that it can be explained on proper dynamical principles for at first it seemed to be a fresh thing not explicable in the old theories.

These problems which relate to the spectrum of radiation, the spectrum of the atom, the connection between the atoms and the ether all involve gyrostatic properties—the relation between "translation" and "spin." Wherever you have electro-magnetism you have what in mathematics is called "curl." If we had mathematical physics here I would urge you to pay great attention to "curl" because I feel that in it is a theory of the ether, *i.e.*, in the relation between translation and spin. There is in the ether itself, I believe, a tremendous spin always going on, and if we could get at that we should begin to understand the inter-relations between ether, matter and the electron in a way which at present we do not. (*Loud and continued applause.*)

**Mr. A. A. Campbell Swinton.**

It is my pleasing duty to ask you to give a very hearty vote of thanks to Dr. Sir Oliver Lodge for the very interesting and I may say wonderful address that he has given us this afternoon. He has touched upon the most difficult subjects and made us all think that we understand them, at any rate for the moment—whether we shall think it in a day or two's time I am not so sure—but in a way he has made everything extraordinarily plain, and done it in a style which I do not think has been imitated by any other living man.

I am personally too young to remember the announcement of Maxwell's discoveries, and I am afraid I should not have understood them had I been old enough to read them, but I do remember some of the very early things which brought about this great science of Wireless Telegraphy.

I was present at the lecture at the Royal Institution given by Sir Oliver Lodge, I think, in 1894, when he gave a wonderful experimental lecture on the work of Hertz and showed us for the first time the sending of wireless signals over considerable distances of space. Even before that, I think about two years before that, at the British Association meeting in Edinburgh—there was, I think, the first public exhibition in this country of a coherer, and it was shown by Dawson Turner, and it was not what most of you would expect. It was in the form of a coherer such as we are accustomed to use, but it consisted of a stick of sulphur in which metal filings had been melted. It was a solid stick of sulphur and connected in the circuit with two clips. When a spark was made in the neighbourhood, it cohered just like ordinary coherers with loose filings do. It is to be remembered that even before the coherer, Professor Hughes, who was President of the Institution of Electrical Engineers, in whose hall we are sitting, had made experiments on the subject of transmitting signals through space, which he had never published, although he showed them to some of his scientific acquaintances. These experiments have now become known to us by the fact that his note-books, in which he wrote accounts of everything that was done, have been bequeathed to the British Museum by the late Mrs. Hughes. More than that, owing to evidences in these note-books, at some period or other he must have had a great deal of apparatus made with his own hands. That apparatus has now been found in a warehouse off the Tottenham Court Road together with a whole lot of Hughes' effects, including umbrellas and books, etc., and now is in the South Kensington Museum. Hughes had no idea of electric waves—at least that is the impression I have got from his note-books—but still he arrived at some very wonderful results, for he produced signals over hundreds of yards.

This has now all been published. There is an account of it in the just issued number of the *Journal of the Institution of Electrical Engineers*. I thought I would just refer to it, as it goes back a little on similar lines to what Sir Oliver Lodge has been saying, so I will ask you to accord Sir Oliver Lodge a hearty vote of thanks for the wonderful lecture address which he has delivered to-night. (*Applause.*)

**Professor G. W. O. Howe.**

I have been asked to second this vote of thanks.

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and I rise to do so with very great pleasure. I am sure we all feel that it is a great honour for the Wireless Society of London to have had Sir Oliver Lodge here this evening to give us this very inspiring lecture. Not only have we learnt much about the early history of wireless telegraphy, but I am sure we will all leave this building with our heads thrown back and our chests thrown out, as we realise we are all "going round the sun on our own." I attended a lecture by Sir Oliver Lodge about two years ago at the Royal Society of Arts. I hope he will not feel hurt if I say I have forgotten what it was about, but I remember the closing expression which was the advice not to throw the ether overboard as there was such a lot of it. Another remark that sticks in my mind was not made by Sir Oliver but by my neighbour at that meeting—a well-known electrical engineer—who said what a wonderful man Sir Oliver was to bring all this abstruse scientific matter down to the level of the intelligence of a Member of Parliament. (I do not want to insult the audience by suggesting any close analogy.)

One thing which has been forced upon me in listening to this wonderful address this evening has been the importance of pure scientific research which at the time had no apparent application. The workers in the early days to whom Sir Oliver has referred—Clerk Maxwell, Hertz and all those others—had no idea that what they were doing had any practical application whatever; it was merely pure love of search for all scientific things, and I think when we realise now the enormous benefit that their work has been to mankind, it should prevent us from referring scornfully at the present day to the vast amount of the pure scientific work that is being done without any immediate prospect of application.

I therefore feel sure that I am voicing the opinion of everyone here when I say that we all feel very grateful to Sir Oliver for coming here this evening and giving us such a lecture with so many beautiful reminiscences of the past, and so many thoughts with which he has enlivened his discourse and given us new ideas. I could not help thinking, towards the close of his lecture, what a good thing it would be if Sir Oliver were forced to read all the modern papers on advanced physics and then forced to serve it up to audiences such as this, so that we could understand what it was about. I have much pleasure in seconding the vote of thanks. (*Loud and continued applause.*)

### Admiral of the Fleet, Sir Henry Jackson.

I take it your applause passes that resolution. I think it is difficult to say which part of Sir Oliver Lodge's lecture was the most instructive, the historical, or the descriptive, or the very latest modern particulars about the Quantum Theory. It ought to be borne in mind that we owe him a great vote of thanks for bringing to our notice the work done by Prof. Hertz, and by those who are now dead and gone, but never thought that their wonderful work would be of any practical use. We must remember that we are all interested in the modern side of this work, and let us, as we do our daily work on wireless, not forget what these men did for us. For it is due to them that you have now got this occupation. Clerk Maxwell certainly stands out first, Hertz comes second I suppose, besides the others which have been mentioned, and I think we must not go away with our chests thrown out and too proud because we think we know all about it, because I think there is a great deal more yet to be learnt about wireless telegraphy, and as Sir Oliver pointed out to-night, we are only on the stepping-stone to the quantum theory.

I will not occupy your time further. Sir Oliver, I will ask you to accept the thanks of the Members of the Society and the audience here for your very instructive lecture. (*Loud and continued applause.*)

### Sir Oliver Lodge.

I am obliged to Mr. Campbell Swinton and Professor Howe for what they have said. I will not follow Professor Howe into politics, but I do heartily agree with what he says, as I suppose we are all agreed, as to the importance of pure science. That is sowing the seed, and we are reaping the crop. I have not dealt with the recent advances of wireless because, as I said, I expect most of you in this room know more about it than I do, but I may incidentally mention that my friend and assistant, Mr. Robinson, and I have a little scheme on hand, but I refrained from saying anything about it because I have sometimes talked too soon about something which ultimately became of some use, and so I thought I would not err in this direction this time.

I therefore kept off that subject, but there are many phases of possible discovery before us. There is the whole idea of atomic energy and the means of getting at it. You are harnessing the electrons now, directing them, making them do what you want, in the wonderful instrument with which no doubt you are most enthusiastically working, but you have to supply the energy. You are not at present tapping the energy of the earth. That has got to be done some day, and I hope some of you will do it.

We are living in an astonishing epoch in physical science. I felt that towards the end of the last century, and I suppose you feel it now in the early part of the twentieth century. There are a number of discoveries waiting to be made. The electron itself was only discovered in 1889, it is only just as old as this century—and think of all that it means now.

I concluded in one of my lectures at the Royal Institution by likening the scientific worker to a boy sitting at the silent keyboard of a deserted organ and playing on its keys; an organ into which an unseen power began to blow a vivifying breath. Astonished he finds that the touch of his fingers now elicits a responsive note and he hesitates, half delighted, half affrighted, lest he be deafened by the chords which he could seem to summon almost at will. That is our position in science to-day. (*Loud and continued applause.*)

**The List of Regular Transmissions which is published from time to time is now undergoing careful revision, and it is hoped that the revised list will be completed for inclusion in an early issue in August.**

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# Screening Valve Oscillators

## THE ELIMINATION OF HIGH FREQUENCY RADIATION

IN a recent paper read before the Physical Society of London, by R. L. Smith-Rose, some experiments that have been carried out at the National Physical Laboratory on the screening of a valve oscillator, such as a heterodyne, were described in detail. The problem of screening a piece of apparatus from the effects of a high-frequency electromagnetic field is known to be very much more difficult than screening it from steady electric or magnetic fields. Electrostatic screening may be accomplished by surrounding the apparatus by a metal covering, which need not be completely continuous—such, for example, as metal gauze—and magnetic screening from a steady field can be accomplished by surrounding the apparatus by a heavy iron screen. Experiments with high-frequency fields, however, give the impression that the difficulty of such screening is much greater, but this is largely a false idea due to the fact that the induced E.M.F. in any circuit placed in an alternating magnetic field is directly proportional to the frequency, and therefore becomes very large at the frequencies used in radio work. It is essentially this fact, coupled with the high amplifications possible with multi-stage valve receivers, that lead to unexpected results when endeavouring to shield instruments from radio frequency fields.

The experiments that were carried out, arose from the need for developing a local heterodyne oscillation generator for use in connection with directional reception. The heterodyne oscillator can be operated entirely from a 6-volt battery and the problem is to screen the receiving apparatus from the effects induced directly by the oscillator, which would tend to distort the directional readings obtained with the receiver. The transfer of electrical energy from one oscillating circuit to another may take place either by mutual induction or by radiation, or by both of these methods. In the case under consideration—viz., that of a heterodyne oscillator near to a receiving apparatus—the transfer is almost entirely by mutual induction, and the problem may therefore be considered correctly as the limiting of the high frequency magnetic field around the oscillator by induced eddy currents in the screening body.

The first experiments made in this direction were carried out with an "R" valve, operating from a 6-volt battery, and having a wavelength adjustable between 1,000 and 10,000 metres. With this instrument used in conjunction with a large frame aerial and a seven-valve amplifier, signals from the more powerful C.W. stations could be perceived even when the local oscillator was quite 100 feet away from the amplifier. This indicated how very small is the oscillating current required to give a beat note with the incoming signals. When the oscillator and its battery were placed inside a thin copper box, with a loose-fitting copper lid, the induced oscillations in the receiving coil were considerably reduced in strength and were only effective in producing beats when the oscillator was within 20 feet of the coil. The use of a galvanised iron box gave similar results. In both these cases it was noticed that the placing in position of the lid of the screening box had a considerable effect on the reduction of the induced field, but that the position of the open end of the box relative to the receiving frame aerial appeared to be immaterial to the strength of the induced currents.

The oscillator and its battery were next placed inside the copper box as above, and this was in turn supported on blocks of paraffin wax inside an iron box, the respective lids of the boxes being in position. In this condition the beat note was only appreciable when the boxes were placed within about 12 feet of the frame aerial. By the use of a small search coil attached to the amplifier, it was proved that a considerable proportion of the escaping energy came out through the space between the lid and the sides of the box, the lid having an overlap of about ½" only. By fitting another lid having an overlap of 3" all round, the effectiveness of the screening was further increased. Experiments were also made with screening consisting of two metallic boxes of various sizes, one being inside the other, and with various arrangements of lids, giving results similar to those obtained with the above-described arrangement.

Tests were also conducted on the effect of bringing connecting leads outside the screening boxes in order to provide a means of definitely coupling the heterodyne to the receiver itself, but as usually experienced in such cases, it was found that as soon as any part of the wire was exposed outside the metal screening, powerful beat-note signals were heard in the receiving amplifier.

As a result of the tests a design for a screened oscillator was prepared, using a wooden box, double-lined with sheet copper, 1/64" thick, fitted with an inner copper lid, and with a second enveloping lid constructed of wood and double-lined with sheet copper. Ebonite connecting pins were used between the control handles on top of the lid and the corresponding condenser knobs, switches, etc., within the box. The metal parts of the control handles were in metallic contact with the outer coating of copper. A separate coil within the box was used to couple to the inductance of the oscillator circuit, and leads from this coil were led out of the box through metallic sheathed wires to a double D-shaped coil to which was coupled a second pair of D-shaped coils, the terminals of which form the outer terminals of the instrument.

The following are the chief features of the instrument:—

1. The entire control of the oscillator is obtained from outside, and it need never be opened except for inspection or for recharging of the accumulator, the complete oscillator with its batteries, etc., being within the sheathing.

2. The opening of the box is a simple operation and does not necessitate the breaking of soldered joints, etc., although when in normal working condition close metallic contact is secured at all joints

3. No part of the oscillator circuit itself is

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outside the inner metallic casing, and the external coupling is made through an astatic coupling arrangement (the double D coils).

4. Variations of the coupling of the D-shaped coils forms a convenient means of varying the effective strength of the heterodyne.

When using this oscillator in conjunction with a rotatable frame aerial and amplifier for D.F. work, it was found that it caused no appreciable errors in the observed bearings, thus proving the effectiveness of the screening, provided that the oscillator was kept outside the frame itself. If mounted at the centre of the frame, it caused variable errors up to a maximum of 2°.

Soldering up the joints of a simple *copper* box surrounding an oscillator was found to reduce considerably the energy radiated from the box, but some still passed apparently through the metal itself, but a similar experiment made with a tinned iron box proved that the iron was much more opaque to the radiation than the copper, as soldering up all the cracks cut off the radiation completely. The theory of the penetration of high frequency currents into metal indicates that such a difference is to be expected and that in fact, iron should be equivalent to between four and six times the thickness of copper. Hence it is only possible to screen a valve oscillator completely (*i.e.*, completely as far as an ordinary H.F. amplifier is concerned) by enclosing it inside a hermetically sealed box of tinned iron of sufficient thickness to prevent the direct penetration of the H.F. magnetic field through it. A mercury seal for the lid of the tinned iron box proved equally effective to the solder, but the slightest crack not closed allowed a relatively large escape of radiation. For complete screening in this manner no controls can be carried outside the box, unless with careful design it should prove possible to seal with mercury these moving parts as well. If controls cannot be carried outside the screening a large part of the value of the heterodyne is lost, especially since the frequency of the oscillator is changed by a considerable amount when the lid is put on the box, owing to its effect upon the inductance of the coil in the oscillation circuit.

The efficiency of these screening methods depends upon the frequency of the oscillations, and decreases with increase of wavelengths—the longer wavelengths proving more difficult to screen. Since, however, the amplifier and its associated circuits are much less affected by the stray fields of longer wavelength, the difference is not so serious as the mathematical theory would at first lead one to expect. The difficulty of screening amplifiers, etc., from disturbing low-frequency fields, however, rather tends to emphasise this fact, and to confirm the general results given by the theory.

The difficulties of high frequency screening arise mainly, therefore, from the extreme sensitiveness of modern amplifiers, as compared with galvanometers and instruments of a similar class for which magnetic screening (low frequency) is more usually called for. Given the same sensitivity of detecting instrument, however, the theory indicates that to obtain the same effectiveness for the screening, the metal would need to be about 80 times thicker for a 100 ~ magnetic field than for an oscillation with a 300-metre wavelength.

To effectively screen a low-frequency amplifier, or note magnifier from disturbances would, therefore, seem to require much more massive screening than is ordinarily employed for this purpose.

P.R.C.

# Questions and Answers

## INTRODUCTION OF SYSTEM OF REPLY BY POST

In the issue of *The Wireless World* for December 10th, 1921, a note appeared regarding the "Questions and Answers" columns of the magazine pointing out the necessity for certain changes on account of the growth of this section of the magazine. At the time this note appeared four or five pages were being devoted to this section in each issue, the Journal then being published fortnightly. Although *The Wireless World and Radio Review* now appears twice as often and we have recently been devoting eight pages an issue to this section it has, in spite of this, been found impossible to keep pace with the demand for information through this Journal in such a way as to give prompt replies to queries.

During the last few weeks the increase in the number of questions received has been enormous, and it is no doubt the result of the big increase in the circulation of the Journal, brought about in part by the ever-growing popularity of wireless. As might be expected, quite a large proportion of the questions now being received are from beginners in wireless who have not back numbers of the Journal to refer to. Taking these circumstances into consideration, it has been decided to form a special department of the Editorial Staff of the Journal to deal exclusively with this section, and our proposal is to introduce a postal reply service (when a nominal charge will be made) in addition to maintaining our present free service. The advantages which the reader will gain from the introduction of a postal reply service will be found principally in a very great saving of time in receiving replies, whilst those who do not wish to avail themselves of the postal service will not suffer in any way as their questions will be included in due course in the Journal as hitherto, but a delay of two or three issues before answers can be published must be expected.

In order to cover certain clerical expenses which must necessarily be involved, it is necessary to make a nominal charge for replies to questions through the post, and the rules under which the "Questions and Answers" Section will be run from the date of publication of this issue will be found on page 334.

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# List of Experimental Transmitting Stations Licensed in the United Kingdom

In our issue of June 3rd we published a letter from the Postmaster-General to the effect that the hours of transmission are no longer restricted. Transmission is permitted for an aggregate maximum of two hours in each twenty-four, provided listening-in on the wavelength used is practised. Any single transmission must be no longer than ten consecutive minutes, and be followed by three minutes of listening-in on the wavelength used for transmission.

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| **2 AA** | — | — | Radio Communication Company (Slough Experimental Station). |
| **2 AB** | — | Spark, C.W. and Telephony | Capt. H. de A. Donisthorpe, London. |
| **2 AF** | — | C.W. | A. Rickard Taylor, 49, Idmiston Road, W. Norwood. |
| **2 AG** | — | C.W. | A. Rickard Taylor, 49, Idmiston Road, W. Norwood. |
| **2 AH** | — | C.W. | Oxford. |
| **2 AK** | — | Spark, C.W. and Telephony | R. M. Radio Ltd., Townsend Mills, Worcester. |
| **2 AL** | — | C.W. and Telephony | W. Halstead, Briar Road, Briar Lane, Thornton-le-Fylde. |
| **2 AN** | — | C.W. and Telephony | A. W. Sharman, Kelvin Lodge, 1, Morella Road, S.W. |
| **2 AQ** | — | Spark, C.W. and Telephony | Davis, Thornton Heath, London, S.W. |
| **2 AR** | — | — | E. Gaze, 3, Archibald Street, Gloucester. |
| **2 AU** | — | — | A. C. Bull, 25, Fairland Road, West Ham, E.15. |
| **2 AW** | 100 | C.W. and Telephony | H. H. Burbury, Crigglestone, Wakefield. |
| **2 AX** | 10 | — | Geo. Sutton, 18, Melford Road, S.E.22. |
| **2 AZ** | — | Spark, C.W. and Telephony | William Le Queux. |
| **2 BM** | — | C.W. and Telephony | J. H. A. Whitehouse, 25, Ennersdale Road, New Brighton, Cheshire. |
| **BXH** | — | — | Capt. C. H. Bailey, Cliffaes, Crickhowell, Abergavenny. |
| **2 BZ** | 10 | — | Basil Davis, Electric Pavilion, Marble Arch, W.1. |
| **2 CH** | 10 | — | Science Society, The School, Oundle, Northants. |
| **2 CI** | 10 | Spark | R. Brooks King, Widcombe, Taunton. |
| **2 CZ** | 10 | Spark, C.W., Tonic-Train and Telephony. | C. Atkinson, 17, Beaumont Road, Leicester. |
| **2 DC** | 10 | — | M. Child, 60, Ashworth Mansions, Maida Vale. |
| **2 DD** | 10 | — | A. C. Davis, 105, Brynland Avenue, Bristol. |
| **2 DF** | — | — | Mitchell's Electric and Wireless, Ltd., Peckham. |

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| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 DG | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. |
| 2 DH | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. Portable set. |
| 2 DI | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. |
| 2 DJ | 10 | — | A. T. Lee, The Court, Alvaston, Derby. |
| 2 DT | — | — | Barrow and District Wireless Association. |
| 2 DX | 10&50 | C.W. and Telephony - - | W. K. Alford, "Rosedene," Camberley, Surrey. |
| 2 DY | — | — | F. Haynes, 157, Phillip Lane, S. Tottenham, N.15. |
| 2 DZ | — | — | F. Haynes, 26, Avenue Road, S. Tottenham, N.15. |
| 2 FA | — | — | F. G. Bennett, 16, Tivoli Road, Crouch End, N.8. |
| 2 FB | 10 | Spark, C.W. and Telephony - | W. Ison, 80, Harnham Road, Salisbury. |
| 2 FC | — | — | London, S.E. |
| 2 FG | — | Spark, C.W. and Telephony - | L. McMichael, 32, Quex Road, W. Hampstead. |
| 2 FH | 10 | C.W. and Telephony - - | T. S. Rogers, 2, Park Hill, Moseley, Birmingham. |
| 2 FL | 100, 50 | Spark and C.W. - - - - | C. Wilcox, 21, George Street, Warminster, Wilts. |
| 2 FN | 10 | — | L. Baker, Ruddington, Notts. |
| 2 FP | 10 | Spark, Telephony, C.W. and T.T. | F. Foulger, 118, Pepys Road, S.E.14. |
| 2 FQ | — | Spark, C.W. and Telephony - | Burndept Ltd. Experimental Station, Blackheath. |
| 2 FR | — | Spark - - - - - - - | S. Rudeforth, 54, Worthing Street, Hull. |
| 2 FU | 10 | Spark, C.W. and Telephony - | E. T. Manley, Jr., 27, Home Park Road, Wimbledon Park, S.W.19. |
| 2 FW | — | Spark - - - - - - | Rev. D. Thomas, St. Paul's B.P. Scouts, Bournemouth. Also Portable Set. |
| 2 FX | — | Spark, C.W., T.T. and Telephony. | H. C. Binden, Bournemouth. |
| 2 FZ | 10 | Spark, C.W. and Telephony - | Manchester Wireless Society, Headquarters, Albion Hotel, Piccadilly, Manchester. Also Portable Set same details and call sign. |
| 2 GD | 10 | For Indoor Transmissions only | Birmingham Wireless Experimental Club, Digbeth Institute, Birmingham. |
| 2 GG | — | — | A. H. Kidd. |
| 2 GL | 10 | C.W. and Telephony - - | W. J. Henderson, 2, Hollywood Road, S.W.10. |
| 2 GP | — | C.W., T.T., Spark and Telephony. | W. Gaitland, Highbury, N. |

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| 2 GQ | 10 | Spark $\frac{?}{\lambda}$ | 1st Taunton Scouts, Parish Buildings, Wilton. |
| 2 GR | — | — | T. Forsyth, Ashington. |
| 2 GS | — | — | T. Forsyth, Ashington. Portable Set. |
| 2 GU | 10 | — | Halifax Wireless Club. |
| 2 GV | 10 | — | Rev. J. Rigby, St. Lawrence Vicarage, Bristol. |
| 2 GW | 10 | Spark, C.W. and Telephony | Allan Cash, Foxley Mount, Lymn, Cheshire. |
| 2 GZ | — | C.W. and Spark | A. L. Megson, Bowdon. |
| 2 HA | — | C.W. and Spark | A. L. Megson, Bowdon. Portable Set. |
| 2 HB | 10 | C.W. and Spark | L. H. Lomas, Macclesfield. |
| 2 HC | 10 | C.W. and Spark | J. W. White, Windcombe Lodge, Bucklebury, near Reading. |
| 2 HG | — | — | T. Boutland, Senr., Ashington. |
| 2 HH | — | — | T. Boutland, Jr., Ashington. |
| 2 HK | — | — | A. A. Campbell Swinton, Chester Square, W. |
| 2 HP | 10 | C.W. and Telephony | H. C. Woodhall, 10, Holborn House, E.C.1. |
| 2 HQ | 10 | C.W. and Spark | A. W. Faucett, 11, Leigh Road, Clifton, Bristol. |
| 2 HS | 10 | C.W. Telephony and T.T. | G. W. Hale, 51, Grafton Road, New Malden, Surrey. |
| 2 HT | — | Spark, C.W. and Telephony | R. H. Klein, 18, Crediton Hill, W. Hampstead, N.W.6. |
| 2 HX | — | Spark, C.W. and Telephony | F. A. Love, Ivydene, Guildford Park Road, Guildford. |
| 2 IB | 10 | C.W. and Telephony | W. Bemrose, Littleover Hill, Derby. |
| 2 ID | 10 | C.W. and Spark | E. S. Firth, Thames Ditton. |
| 2 IF | 10 | C.W. and Telephony | S. W. Bligh, 2, North Lane, Canterbury. |
| 2 IH | — | — | Technical College, Cardiff. |
| 2 II | 10 | Spark | Southport Wireless Society, 74a, Kensington Road, Southport. |
| 2 IJ | — | — | Southport Wireless Society, 74a, Kensington Road, Southport. Portable Set. |
| 2 IK | 10 | C.W. and Telephony | County High School for Boys, Altrincham, Cheshire. |
| 2 IL | 10 | Telephony | H. R. Goodall, "Fernlea," Winchester Road, Bassett, Southampton. |
| 2 IN | 10 | C.W., Spark and Telephony | J. E. Fish, "Thornleigh," Thornton-le-Fylde, Near Blackpool. |
| 2 IQ | — | C.W. and Telephony | W. A. Ward, 26, Marlborough Road, Sheffield. |
| 2 IS | — | — | Rev. H. W. Doudney, St. Luke's Vicarage, Bath. |

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| 2 IT | — | — | Rev. H. W. Doudney, St. Luke's Vicarage, Bath. Portable Set. |
| 2 IU | 10 | — | G. A. E. Roberts, Twyford, Winchester. |
| 2 IV | 10 | Spark, C.W. and Telephony - | L. F. White, Priory Road, Knowle, Bristol. |
| 2 IW | 10 | — | G. R. March, Twyford, Winchester. |
| 2 IX | 10 | C.W. and Telephony - - | S. G. Taylor, Littleover, Derby. |
| 2 IY | 10 | C.W. and Telephony - - | J. Briggs, City School of Wireless Telegraphy, 66½, Corporation Street, Birmingham. |
| 2 JF | 10 | Spark, C.W. and Telephony - | C. G. Williams, 22, Scholar Street, Sefton Park, Liverpool. |
| 2 JG | — | — | W. A. Seed, Crigglestone, Near Wakefield. |
| 2 JJ | 10 | Spark, C.W. and Telephony - | C. Worthy, 4, Riversdale Road, Egremont, Wallasey. |
| 2 JK | 10 | Spark, C.W., T.T. and Telephony. | Philip R. Coursey, 138, Muswell Hill Road, N.10. |
| 2 JL | 10 | Spark, C.W. and Telephony - | G. G. Bailey, The Beeches, Cowley, Middlesex. |
| 2 JM | 10 | Spark, C.W. and Telephony - | G. G. Blake, 10, Onslow Road, Richmond, Surrey. |
| 2 JO | 10 | Spark, C.W. and Telephony - | J. W. Whiteside, 30, Castle Street, Clitheroe, Lancs. |
| 2 JP | — | Spark, C.W. and Telephony - | M. C. Ellison, Hutton's Ambo Hall, York. |
| 2 JU | 10 | Spark, C.W. and Telephony - | E. J. Pearcey, 610, Fulham Road, S.W. |
| 2 JV | 10 | Spark, C.W. and Telephony - | A. G. Robbins, Station Road, Epping. |
| 2 JW | 10 | C.W. and Telephony - - | J. R. Barrast, Westgate Court, Canterbury. |
| 2 JX | 10 | C.W. and Telephony - - | L. Vizard, 12, Seymour Gardens, Ilford. |
| 2 JZ | 10 | C.W. and Telephony - - | R. D. Spence, Craighead House, Huntly, Aberdeenshire. |
| 2 KA | 10 | — | N. Curtis, Belvedere West, Taunton. |
| 2 KB | 10 | C.W., Telephony and T.T. - | W. E. Earp, 675, Moore Road, Mapperley, Nottingham. |
| KCLX | — | Spark - - - - - - - | Professor Wilson, University of London, King's College. |
| 2 KD | 10 | C.W., T.T. and Telephony - | P. Denison, Rostellan, Saville Park, Halifax, York. |
| 2 KF | 10 | C.W. and Telephony - - | J. Partridge, Park Road, Merton, S.W.19. |
| 2 KG | 10 | Spark, C.W. and Telephony - | A. E. Hay, "Glendale," Abernant, Aberdare. |
| 2 KK | 10 | — | Hutchinson & Co. (F. Pinkerton), 101, Dartmouth Road, Forest Hill, S.E.23. |
| 2 KL | 10 | Spark - - - - - - | F. Pemberton, 50, Peak Hill, Sydenham. |
| 2 KM | — | Spark - - - - - - | C. Stainton, 44, Kimberley Street, Hull. |
| 2 KN | — | C.W. and Telephony - - | A. B. Day, Finchley. |

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| 2 KO | 10 | C.W. and Telephony | C. S. Baynton, 48, Russell Road, Moseley, Birmingham. |
| 2 KQ | 10 | — | Wolverhampton (Communication to Taylor Relief Motor Co., Ltd., Cleveland Street, Wolverhampton). |
| 2 KR | 10 | C.W. and Telephony | E. Edmonds, 2 Yew Tree Road, Edgbaston, Birmingham. |
| 2 KS | 10 | Spark, C.W., T.T. and Telephony. | C. Clayton-Breakell, Mill Bank, Church Street, Preston. |
| 2 KT | — | Spark, C.W. and T.T. | J. E. Nickless, 83, Wellington Road, Snaresbrook, E.11. |
| 2 KU | 10 | Spark, Telephony and T.T. | A. J. Selby, 66, Edward Street, Burton-on-Trent. |
| 2 KV | — | C.W. and Telephony | W. J. Crampton, Weybridge. |
| 2 KW | — | C.W. and Telephony | W. R. Burne, Springfield, Thorold Grove, Sale, Cheshire. |
| 2 KY | 10 | C.W. and Telephony | L. Pollard, 209, Cunliffe Road, Blackpool. |
| 2 KZ | 10 | Spark, C.W. and Telephony | B. Clapp, Meadmoor, Brighton Road, Purley. |
| 2 LA | — | C.W. and Telephony | H. F. Yardley, 121, Victoria Road, Headingley, Leeds. |
| 2 LB | — | C.W. and Telephony | H. F. Yardley, 6, Blenheim Terrace, Leeds. |
| 2 LF | — | Spark and C.W. | P. Harris, Chilvester Lodge, Calne, Wilts. |
| 2 LG | 10 | C.W. | H. Whitfield, The Glen, Primrose Lane, Hall Green, Birmingham. |
| 2 LI | — | Spark, C.W. and Telephony | H. E. Wilkinson, Lonsdale Road, N.W.6. |
| 2 LK | 10 | Tonic Train and C.W. | S. Kniveton, Brooklands, Normanton, Yorks. |
| 2 LL | 10 | Tonic Train and C.W. | S. Kniveton, Brooklands, Normanton, Yorks. |
| 2 LO | — | — | Marconi House, Strand, W.C. 2. |
| 2 LP | 10 | Spark, C.W. and Telephony | A. W. Knight, 26, Stanbury Road, S.E. |
| 2 LR | 10 | C.W. and Telephony | John Scott Taggart, 6, Beattyville Gardens, Ilford. |
| 2 LU | 10 | C.W. and Telephony | W. A. Appleton, Wembley Park. |
| 2 LV | — | Spark, C.W. and Telephony | W. R. H. Tingey, Queen Street, Hammersmith. |
| 2 LW | — | Spark, C.W. and Telephony | W. R. H. Tingey, Queen Street, Hammersmith. |
| 2 LY | 10 | Telephony | H. H. Thompson, 59, Redlands Road, Penarth, Glamorgan. |
| 2 LZ | 10 | Spark, C.W. and Telephony | F. A. Mayer, Stilemans, Wickford, Essex. |
| 2 MA | 10 | Spark | P. S. Savage, 14/16, Norwich Road, Lowestoft. |
| 2 MB | 10 | C.W. and Telephony | E. H. Jeynes, 67, St. Paul's Road, Gloucester. |
| 2 MD | 10 | Spark, C.W. and Telephony | C. Chipperfield, Victoria Road, Oulton Broad, Lowestoft. |
| 2 MF | — | C.W. and Telephony | Marconi Scientific Instrument Co., Ltd., 21/25, St. Anne's Court, Dean Street, W.1. |

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|---|---|---|---|
| 2 MG | 10 | C.W. and Telephony | C. E. Millar, Arndene, Bearsden, Near Glasgow. |
| 2 MH | 10 | Telephony | A. Lawton, Brown Edge Vicarage, Stoke-on-Trent. |
| 2 MI | 10 | Spark, C.W. and Telephony | L. McMichael, Stag Works, Kilburn, N.W. |
| 2 MK | 10 | — | A. W. Hambling, 23, Winchester Avenue, Brondesbury, N.W.6. |
| 2 ML | 10 | Spark, C.W. and Telephony | R. C. Clinker, Bilton, Rugby. |
| 2 MO | — | Spark, C.W. and Telephony | Burndept, Ltd. Experimental Station, Chiswick. |
| 2 MR | 10 | Spark, C.W. and Telephony | R. H. Reece, The Corner House, 62, Addison Gardens, London, W.14. |
| 2 MS | 10 | C.W., Spark and Telephony | R. H. Reece, "Basketts," Birchington, Kent. |
| 2 MT | 1,000 | Spark, C.W. and Telephony | Marconi Scientific Instrument Co., Ltd. (Near Chelmsford. Station for specially authorised transmissions to amateurs.) |
| 2 MY | 10 | C.W. and Spark | H. M. Hodgson, Clifton House, Hartford, Cheshire. |
| 2 MZ | — | — | J. Mayall, "Burfield," St. Paul's Road, Gloucester. |
| 2 NA | 10 | C.W. and Telephony | H. Frost, Longwood, Barr Common, Walsall. |
| 2 NB | — | — | J. W. Barnaby, Sylvan House, Broad Road, Sale, Cheshire. |
| 2 NH | 10 | C.W. and Telephony | O. R. C. Sherwood, 41, Queen's Gate Gardens, S.W. |
| 2 NI | 10 | — | P. H. Lyne, Dartford and District Wireless Society. |
| 2 NJ | — | — | Lee, S.E.12. |
| 2 NL | — | — | F. J. Hughes, "Ashdene," 129, Well Road, Bath. |
| 2 NM | — | C.W. and Telephony | G. Marcuse, Coombe Dingle, Queen's Park, Caterham, Surrey. |
| 2 NN | 10 | — | Brig.-General Palmer, Epping. |
| 2 NO | 10 | C.W., T.T. and Telephony | H. R. Adams, Crescent Cabinet Works, Walsall. |
| 2 NQ | — | — | Morton, Kingston. |
| 2 NP | — | C.W. and Telephony | H. S. Treadwell, Middleton Cheney, Banbury. 'Phone: 3 Y Banbury. |
| 2 NR | — | — | J. Knowles Hassall, Mount Pleasant Works, Wooden Box, Near Burton-on-Trent. |
| 2 NY | 10 | C.W., T.T. and Telephony | J. N. C. Bradshaw, Bilsboro', Near Preston. |
| 2 NZ | 10 | C.W., T.T. and Telephony | J. N. C. Bradshaw, Bilsboro', Near Preston. |
| 2 OF | 10 | Spark, C.W. and Telephony | H. C. Trent, Secondary School, Lowestoft. |
| 2 OI | — | C.W., Telephony and T.T. | Colin Bain, Newcastle-on-Tyne. |
| 2 OM | — | C.W. and Telephony | H. S. Walker, Park Lodge, Brentford, Middlesex. |
| 2 ON | 10 | Spark, C.W. and Telephony | Major H. C. Parker, 56, Stern Hall Street, Walthamstow, E.17. |



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|---|---|---|---|
| 2 OY | 10 | C.W. and Telephony | Capt. E. J. Hobbs, 4th Tank Battn., Wareham. |
| 2 PA | — | Spark, C.W. and Telephony | C. Z. Auckland & Son, 395, St. John Street, E.C.1. |
| 2 PF | 10 | Spark | F. Foulger, S.E.14. |
| 2 PI | 10 | Spark, C.W. and Telephony | Loughborough College, Leicestershire. |
| 2 PJ | 10 | Spark, C.W. and Telephony | Loughborough College, Leicestershire. |
| 2 PR | 10 | C.W. and Telephony | A. E. Whitehead, "Hollingwood," King's Ride. Camberley, Surrey. |
| 2 PS | 10 | C.W. and Telephony | J. H. Gill, 18, Fourth Avenue, Sherwood Rise, Nottingham. |
| 2 PU | 10 | Spark, C.W. and Telephony | C. R. W. Chapman, "Nirvana," 44, Chaplin Road. Wembley. |
| 2 PX | 10 | C.W. and Telephony | H. H. Lassman, 4, Avenue Parade, Barking Road. East Ham. |
| 2 QH | 10 | C.W., T.T. and Telephony | A. Hewins, 42, St. Augustine Avenue, Grimsby. |
| 2 QI | — | — | Balham. |
| 2 QK | 10 | C.W. and Telephony | J. Bever, 85, Emm Lane, Bradford. |
| 2 QL | — | C.W. and Telephony | R. J. Hibberd, Grayswood School, Haslemere, Surrey |
| 2 QN | 10 | — | A. Hobday, Flint House, Northdown Road, Margate. |
| 2 QO | — | Telephony | P. Pritchard, Blenheim House, Broad Street, Hereford. |
| 2 QP | — | C.W., Telephony and Spark | L. C. Grant, 3 Langhorn Street, Newcastle-on-Tyne. |
| 2 QQ | — | — | Burnham & Co., Experimental Station, Wembley. |
| 2 QS | 10 | Spark, C.W. and Telephony | S. Ward, "Ravenswood," 339, Brixton Road, S.W.9. |
| 2 QU | — | — | Blackheath. |
| 2 QY | — | — | London, N.W.6. |
| 2 RB | 10 | Spark, C.W. and Telephony | H. B. Grylls, Trenay Fawton, Carew Road, Eastbourne. |
| 2 RD | 10 | C.W. and Telephony | G. W. Fairall, 27, Newbridge Street, Wolverhampton. |
| 2 RH | 10 | Spark | H. A. Pound, 101, High Street, Broadstairs. |
| 2 RK | — | Spark | A. E. Blackall, 7, Maple Road, Surbiton. |
| 2 RP | 10 | C.W. and Telephony | F. W. Emerson, 178, Heaton Moor Road, Heaton Moor, Near Stockport. |
| 2 RY | — | — | S. Hanley, Forbury, Kintbury, Berks. |
| 2 SD | — | — | J. Mayall, Burfield, St. Paul's Road, Gloucester. Portable Set. |
| 2 SF | — | C.W., T.T. and Telephony | C. Midworth, 4c, Vicarage Mansions, West Green, N.15. |
| 2 SH | — | C.W., T.T. and Telephony | F. L. Hogg, 37, Bishop's Road, N.6. |

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| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 SI | — | Spark, C.W., T.T. and Telephony. | L. C. Holton, 112, Conway Road, London, N.14 |
| 2 SK | — | — | K. G. Styles, 52, Jerningham Road, S.E.14. |
| 2 SL | — | — | A. G. Styles, "Kitscot," Maidstone, Kent. |
| 2 SP | 10 | C.W. and Telephony - - | L. Mansfield "Cregneish" Ley Hey Park, Marple, Ches. |
| 2 SZ | 10 | Spark, C.W. and Telephony - | W. H. Brown, Mill Hill School, N.W.7. |
| 2 SX | 5 | C.W. and Telephony - - | F. B. Baggs, 24, Westhorpe Street, S.W.15. |
| 2 TG | 10 | C.W. and Telepnony - - | Sheffield University, Dept. of Applied Science. St. George's Square, Sheffield. |
| 2 TH | 10 | C.W. - - - - - - - | Sheffield University. Portable Set. |
| 2 TN | 10 | C.W. and Telephony - - | C. E. Stuart, Lyndon Lodge, Polesworth, Tamworth. |
| 2 TO | 10 | C.W. and Telephony - - | F. Townsend, 46, Grove Lane, Ipswich. |
| 2 UG | 10 | C.W. and Telephony - - | W. Humphreys Burton, 103, Portland Road, Nottingham. |
| 2 UJ | — | C.W., Telephony and T.T. - | L. R. Richards, Mona, 25, Cholmeley Park, Highgate, N.6. |
| 2 UM | 10 | Spark, C.W. and Telephony - | H. Lloyd, 3, Ventnor Place, Sheffield. |
| 2 UV | 10 | T.T., C.W. and Telephony - | W. Corsham, 104, Harlesden Gardens, London, N.W.10. |
| 2 UY | 10 | C.W. and Telephony - - | W. Fenn, Holly Cottage, Polesworth, Tamworth. |
| 2 VN | 10 | C.W. and Telephony - - | H. Drury-Lavin, Old House, Sonning, Berks. *'Phone, Sonning 22.* |
| 2 VP | — | — | P. G. A. H. Voigt, Bowdon Mount, 121, Honor Oak Park, S.E.23. |
| 2 VW | — | C.W. and Telephony - - | E. H. Robinson, 125c, Adelaide Road, N.W.3. |
| 2 WB | — | Spark, T.T., C.W. and Telephony. | George W. Jones, 8, Rosebery Street, Wolverhampton. |
| 2 XZ | 10 | C.W. and Telephony - - | Lewis T. Dixon "Strathspray," 4, Heythorp Street, Southfields, S.W. 18. |

*Holders of Experimental Transmitting Licences are requested to notify the Editor of changes in the particulars given above for amendment in subsequent lists. Licensees may find it convenient to include their telephone numbers.*

**With a view to making the List of Regular Transmissions of greater value, special consideration is being given to its revision. The list which is consequently delayed, will appear in an early issue in August.**

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# Time Signals and Weather Reports

BY W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

1. In this and future articles, it is proposed to deal briefly and in a simple manner with time signals, weather reports and other transmissions of special scientific interest, so that the amateur on picking up these signals may be able to decode them and turn them to some practical use. The following transmissions by W/T will therefore come within the scope of these notes :—

(*a*) Time signals—automatic and semi-automatic.

(*b*) Rhythmic time signals.

(*c*) Meteorological messages and forecasts.

(*d*) Seismological radio-telegrams.

(*e*) U.R.S.I. signals.

(*f*) Calibration waves and standard wavelengths.

Details will be given of the various codes in use for these messages, of methods and apparatus employed and times of transmission, together with a brief explanation of how meteorological forecasts are prepared.

(2) Forecasts are perhaps of wider interest than coded meteors and are usually sent out in plain language. The Belgian Meteorological Office transmits daily at noon (G.M.T.) from Uccle, call sign **HS**, a forecast for Belgium and Western Europe in French. The report is issued specially for amateurs, and is therefore transmitted very slowly and repeated. A wavelength of 1,500 metres is used and the message usually lasts about 20 minutes. The Air Ministry also broadcasts daily at 0915 (9.15 a.m. G.M.T.) and 2000 (8 p.m. G.M.T.) on 1,400 metres C.W., a general forecast in plain language based upon observations made at 7h. and 18h. respectively. These messages are sent out from the Air Ministry (G.F.A.) through a Wheatstone tape machine and the rate of sending is about eight words per minute. (See Fig. 1.)

(3) The simplest form of crystal detector

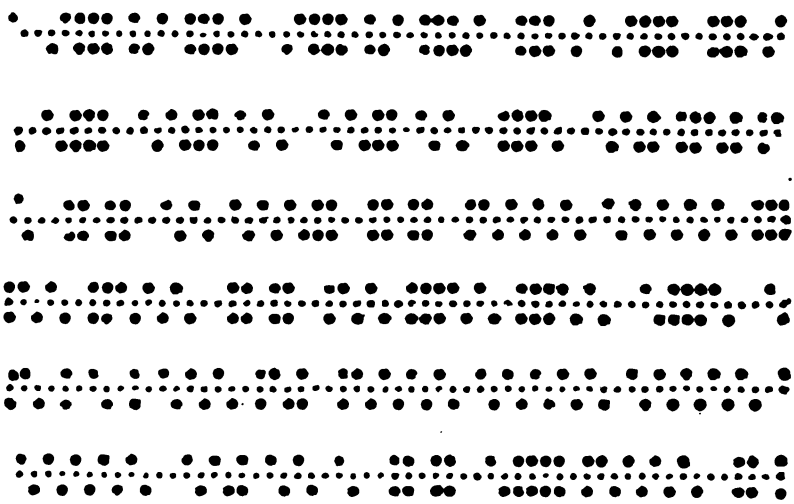

*Fig. 1. Portion of Wheatstone Tape used for transmitting* 1000 *G.M.T. meteor message on June* 10*th from G.F.A. Air Ministry* 1680 *Av.*

2. In the first instance, it may be pointed out that these scientific signals are of special interest to the beginner who is not likely to be expert with the Morse code, for the following reasons :—

(1) Such messages are intended for general scientific use and are therefore transmitted at a relatively slow speed, and so far as meteor messages are concerned consist chiefly of groups of figures in code. A figure code is used with the object of dealing quickly and accurately with a large number of observations of different kinds. The messages may be decoded after they are taken down, and with some practice this can be done quite expeditiously.

will enable the amateur to receive Eiffel Tower time signals and thus put him in possession of Greenwich time to within an error of $\frac{1}{4}$ second. Regarding meteorological information, he will be in receipt of reports usually about $1\frac{1}{2}$ hours after the time observations are made. In this connection the newspaper forecast received at the breakfast table is based on observations made at 6 p.m. the previous evening, and is therefore at least 14 hours "out-of-date," so that for this reason alone it is not to be wondered at that newspaper forecasts do not

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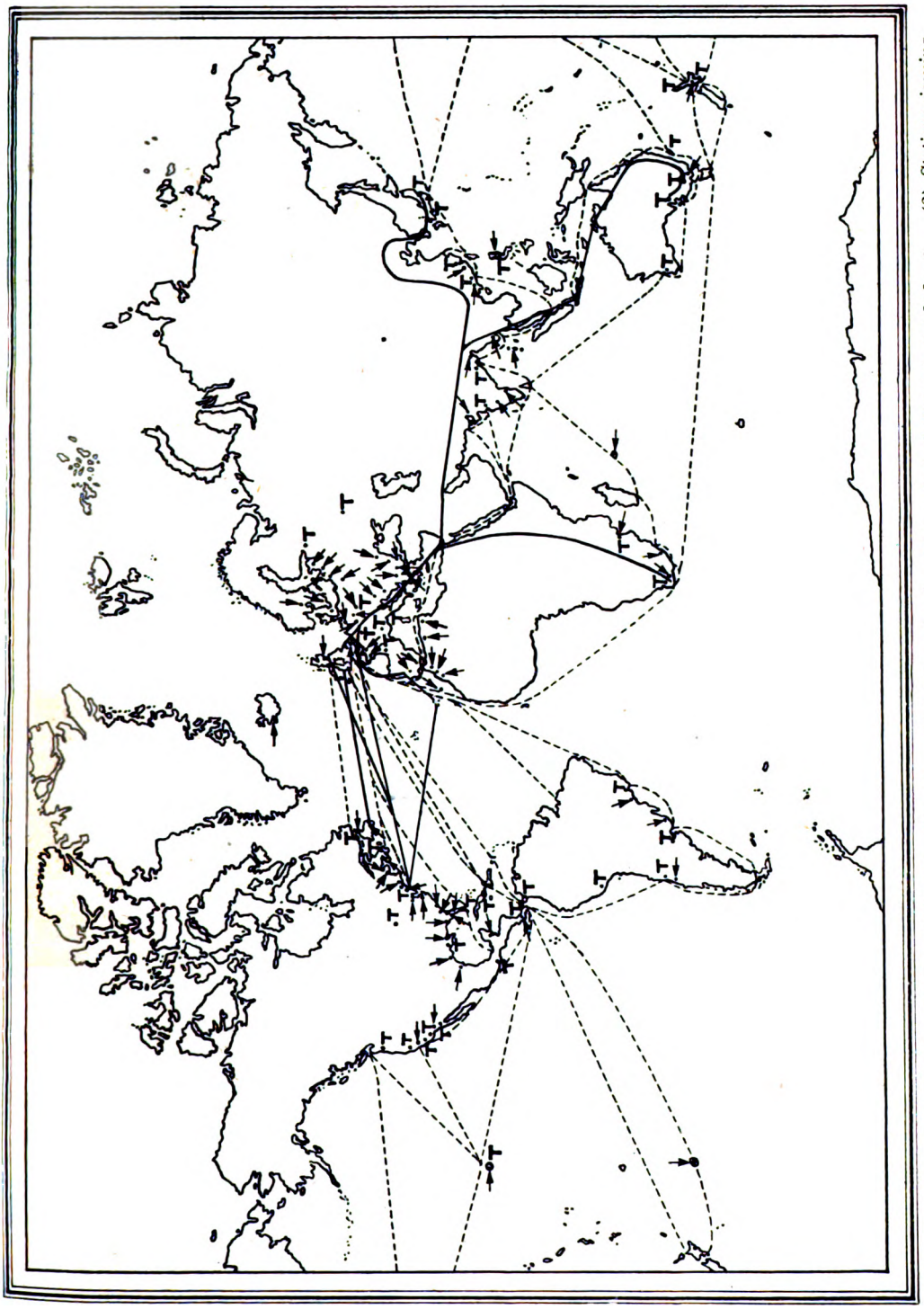

*Fig. 1. Stations supplying Time and Weather Reports. (1) Stations issuing Meteorological Reports marked ⬟. (2) Stations issuing Time Signals marked T. Principal Steamship Routes marked ..... and long-distance Aeroplane Flights marked ——.*

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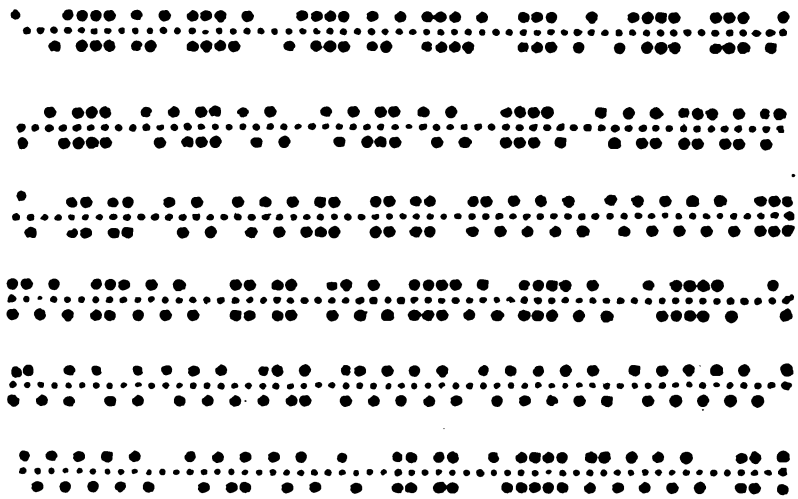

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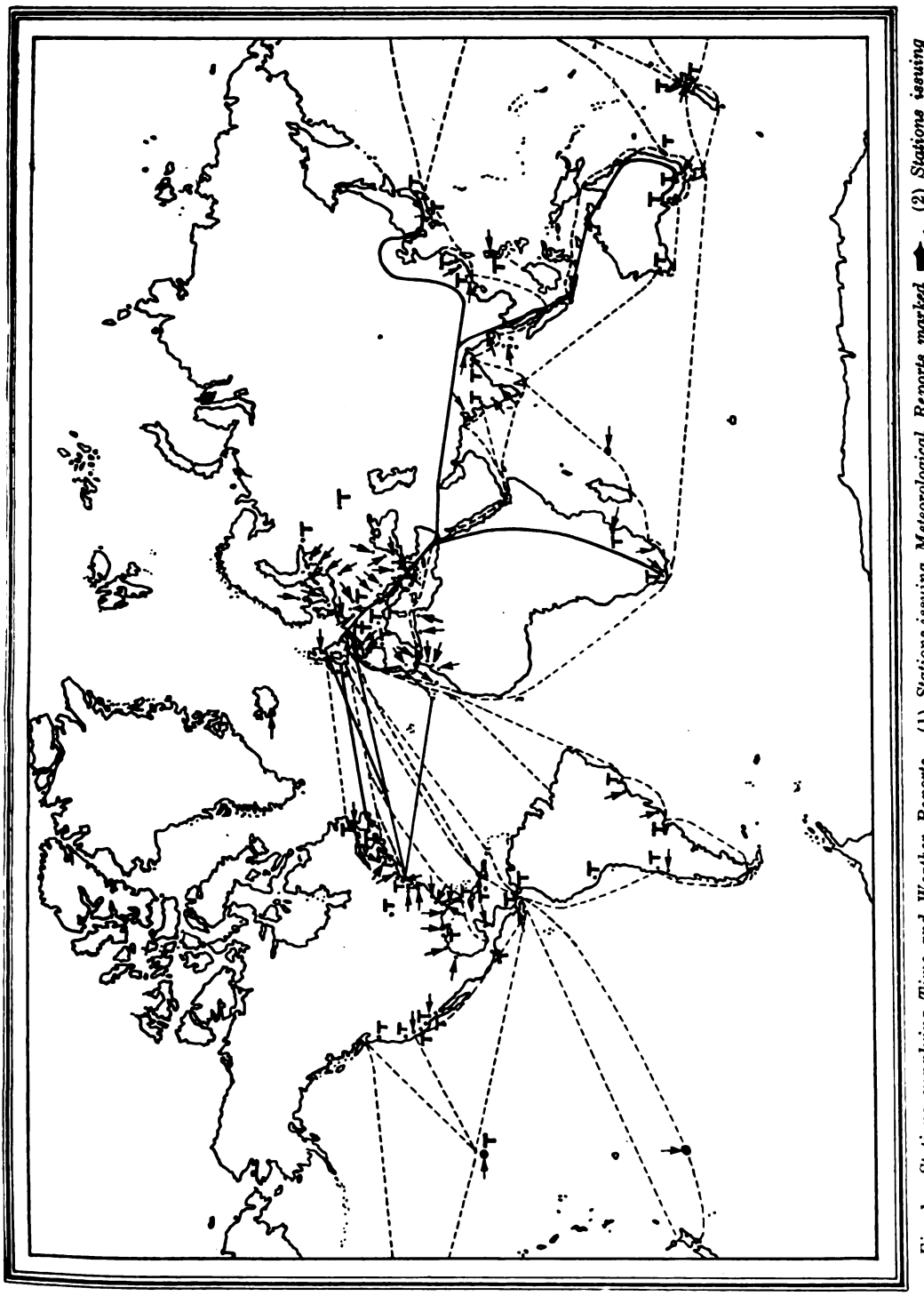

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always entirely agree with the actual prevailing conditions of weather.

3. In the case of some reports too long an interval of time elapses between the times of observations and that of transmission by W/T. This is especially the case with the European weather report issued daily from Paris FL at 11.30 a.m., 4½ hours after the time to which observations relate. The International Convention for Aerial Navigation envisaged a scheme in which all National reports were collected and a selection from these reports issued in collective form from a Central National Office within 1½ hours of the time of observation. Although we are far from this ideal at present, progress has been made as is evidenced in the "up-to-date" information contained in the hourly route meteors issued on the principal aviation routes. In this country the Air Ministry and the Meteorological Service are housed under the same roof at Kingsway, so that we may expect close co-operation between the two services. The importance of early meteorological information regarding the amount of cloud, wind force and visibility at different levels to airmen is fully realised. The chief airway companies operating on the Cross-Channel and London-Amsterdam routes require their pilots to sign an undertaking that they are conversant with meteorological conditions along the route before commencing a journey, and it is within the discretion of a pilot to cancel a flight if he thinks the conditions unsuitable.

4. The accompanying map of the world (Fig. 2) indicates the distribution of stations supplying time and weather information and the extent of the present services. The growing importance of the subject to the seaman, the airman and the general public has found practical expression in the formation of an international body known as The International Commission of Weather Telegraphy charged with the responsibility of devising an International Code. Before the war the recognised, and practically the only method of exchange of weather information, was by ordinary telegram and cable, for in most cases the distances involved are too long to make the telephone practicable. A certain number of reports were received from ships by W/T, although these were by no means regularly received. The Eiffel Tower station had made some headway by issuing a daily weather report from a limited number of reporting stations in Western Europe. At the present time there are many departures from the International Code in the various countries. These are unhappily too frequent, and very often lead to confusion, as for example when wind velocity is given in miles per hour instead of the code agreement of kilometres per second. Another difficulty arises from the fact that in many countries the meteorological services depend upon a single wireless station and consequently the reception of reports from other stations issued at the same hour is impossible.

The two directions then in which progress is desired are (*a*) the "speeding-up" of the issue of reports by W/T, and (*b*) a carefully conceived time-table of transmission times so that the greatest

Paris FL (lat. 48° 52′ N., long. 2° 18′ E).

COMPLETE LIST OF REGULAR DAILY TRANSMISSIONS.

| Time G.M.T. | Nature of Transmission. | Wavelength. | Power in Aerial. |
|---|---|---|---|
| 0220 | Meteor-observations at 1 hr. followed by detailed forecast for France valid until evening of same day. | 2,600 m. Spark | 60 kW. |
| 0820 | Meteor-observations at 7 hr. | 2,600 m. Spark | 60 kW. |
| 0923–0930 | Time signals (automatic) | 2,600 m. Spark | 60 kW. |
| 1000–1003 | Rhythmic signals, 300 beats | 2,600 m. Spark | 60 kW. |
| 1033–1038 | U.R.S.I. signals | 2,600 m. Spark | 60 kW. |
| 1038–1043 | Groups for correcting rhythmic signals | 2,600 m. Spark | 60 kW. |
| 1044–1049 | Time signals (semi-automatic) | 2,600 m. Spark | 60 kW. |
| 1130 | European meteor ob. at 7 hr. followed by detailed forecast for France and Western Europe until the following morning. | 2,600 m. Spark | 60 kW. |
| 1130 | (At end of meteor) Seismological telegram | 2,600 m. Spark | 60 kW. |
| 1200 | Press | 3,200 m. Spark | 60 kW. |
| 1420 | Meteor. Ob. at 13 hr. | 2,600 m. Spark | 60 kW. |
| 1700 | Telephony | 2,600 m. Spark | 1 kW. (approx.) |
| 1710 | Agricultural meteor in plain language (as from February 6th, 1922). | 2,600 m. Spark | 1 kW. (approx.) |
| 1800 | Calibration waves, 1st and 15th of month only | 5,000 m. | 60 kW. (approx.) |
| 1810 | Calibration waves, 1st and 15th of month only | 7,000 m. | 60 kW. (approx.) |
| 1920 | Meteor. Ob. at 18 hr. | 2,600 m. Spark | 60 kW. |
| 1920 | (At end of meteor) Seismological telegram | 2,600 m. Spark | 60 kW. |
| 2200 | Rhythmic signals, 300 beats | 2,600 m. Spark | 60 kW. |
| 2236–2243 | Groups for correcting rhythmic signals | 2,600 m. Spark | 60 kW. |
| 2244–2249 | Time signals (semi-automatic) | 2,600 m. Spark | 60 kW. |

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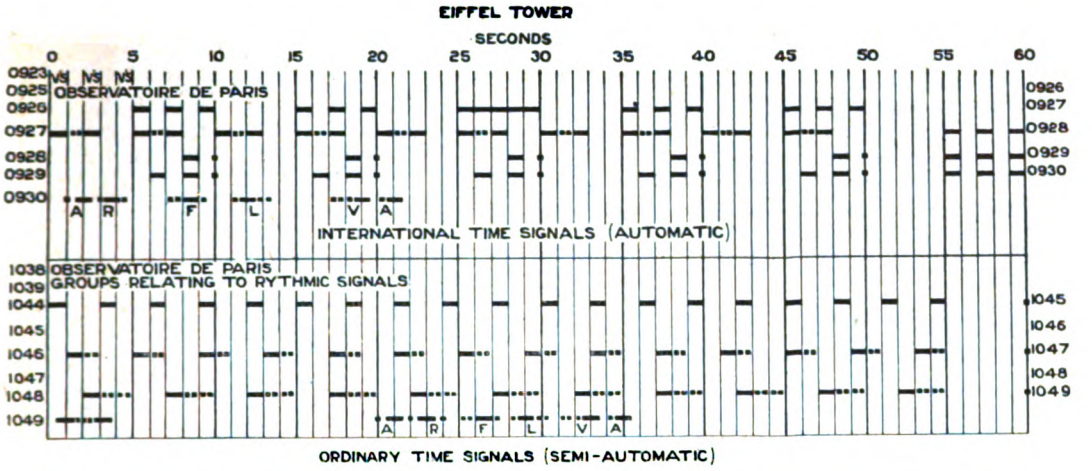


*Fig. 3. Method of transmitting Time Signals. (Ordinary time signals are also transmitted every evening from 2244-2249.)*

possible use may be made of reports issued and that they may be available for the greatest number of countries desiring to have them.

The Table on the previous page gives a complete list of the regular transmissions made every day by the Eiffel Tower **FL** from which it will be seen that the greater part of the daily programme is taken up with these scientific time and weather signals.

A diagram (Fig. 3) is also given showing the method of transmission of time signals from the same station, while a future article will explain the apparatus used in this connection.

# Notes

**Second Reading of Wireless Bill.**

Mr. Kellaway moved the second reading of the Wireless Telegraphy and Signalling Bill in the House of Commons on June 16th. The Bill, he said, did not propose in any way to withdraw from the publicthe advantages ofwireless communication. On the contrary its effect would be, by ensuring the proper use of wireless, to assist its development. Mr. Kellaway said the conditions under which the broadcasting of wireless telephony would be worked had not yet been decided. He did not think it desirable that the work should be carried on by the Government. The Bill was read a second time.

**American Broadcasting Stations No. 300.**

Twenty-six new broadcasting stations were licensed during one week in May in 18 different States. This brings the total stations broadcasting news and entertainment to 300. Five of the new stations are located in California, which leads the list with a total of 59 stations. Ohio is second with 23, Pennsylvania has 20, and New York 18. Texas is no longer the only state with one station, as Maryland, Utah, North and South Dakota each have one only.

To-day, every state except New Hampshire, South Carolina, Delaware, Mississippi, Kentucky, Wyoming and Idaho has one or more broadcasting stations.

The prospective Bill to give the Secretary of Commerce more control over radio transmission stations has not yet been introduced in Congress. Little opposition is expected. Support is guaranteed by nearly 16,000 amateurs.

**Ice Patrol Broadcasting.**

On the closing of the St John's Station reports hitherto transmitted respecting dangers to navigation in the vicinity of the Great Banks of Newfoundland, are to be broadcasted by the United States Coastguard cutters on ice patrol.

**Senatore W. Marconi Receives Medal.**

At a joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers, held on June 20th at the Engineering Societies Building, New York, Senatore Marconi delivered an address on "Radio Telegraphy." He was afterwards presented with The Institute Medal of Honour for 1920.

**Charity Demonstration.**

A wireless demonstration was given by Marconi's Wireless Telegraph Co. on Friday, June 16th, for the benefit of the annual fête and sale in aid of the Actor's Church Union Hostels Fund for Children of Touring Actors, at Caxton Hall, Westminster, the arrangements for which were carried out by Miss Kitty Loftus, in co-operation with the Marconi Company.

There was a demonstration of general wireless reception during the afternoon, and at 8 p.m. a message from the Archbishop of Canterbury, spoken from Marconi House, was received on a loud speaker in the main hall. The message, which contained a warm expression of goodwill and desire for the

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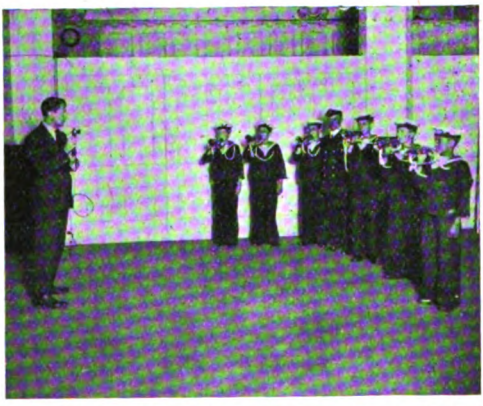
success of the fête, had been sent by the Archbishop of Canterbury to the Bishop of Willesden for transmission by wireless.

Some gramophone music was also given and the demonstration proved of great interest to a large gathering of people.

### Transmission of Memorial Ceremony.

At Marconi House at noon, on June 21st, when the Roll of Honour was unveiled in memory of the 348 men whose names are on it, the ceremony



*Boys of the "Exmouth" sounding the Last Post.*

was broadcasted. The Last Post and Reveille sounded on bugles, and an address by Mr. Godfrey Isaacs was heard by operators in ships all round the coast of the United Kingdom.

### Report on Radio Telephony Conference.

At a conference called by the Secretary of the Department of Commerce at Washington, questions concerning the regulation of radio communication were considered. The conference was held from February 27th to March 2nd, and April 17th to 19th. The conference recommended that the Secretary of Commerce should have authority to control the establishment of all radio transmitting stations except amateur, experimental and Government stations; also the operation of non-governmental radio transmitting stations.

It was recommended that the Secretary of Commerce assign to each radio telephone broadcasting station a permissible power based on the normal range of the station, such normal ranges for the different classes of service to have stipulated average values. Government broadcasting stations were recommended 600 (land) miles; public stations 250 miles, and private and toll stations 50 miles.

An interesting clause in the recommendation was that for the purpose of self-policing among the amateurs, amateur deputy radio inspectors be created, elected from their number in each locality. The duty of the deputy inspector would be to endeavour to the best of his ability to accomplish, under the direction of the district radio inspector observance of the Radio Communication Laws.

## Book Review

HOW TO MAKE GOOD WIRELESS APPARATUS. A Useful American Publication.

Many experimenters who have evolved useful circuits are anxious to embody them in neat, easily handled and robust equipment. They are aware that their apparatus in its experimental form is sensitive and electrically efficient, but owing to the lack of suitable textbooks on instrument design (as distinguished from *circuit* design) they are frequently unable to produce finished apparatus of the style associated with commercial equipment. With this in mind, Mr. M. B. Sleeper (late editor of the Radio section of "Everyday Engineering," and best known to British amateurs as the originator of the first transatlantic amateur tests), has written a useful textbook entitled "How to Make Commercial Type Radio Apparatus,"* in which he deals in detail with a number of American commercial designs, giving much data and photographs of interior construction which are not otherwise available.

The book is not intended for the raw tyro. For this reason all theoretical matter is excluded, and the reader is presumed to understand the principles upon which the apparatus works. The work is divided into four parts, devoted respectively to Receiving Equipment, Transmitting Equipment, Airplane Radio Equipment and Special Notes on Miscellaneous Equipment. In the first portion, which is of particular interest to the experimenter on this side of the Atlantic, some suggestive particulars are given on several types of receiver. The first chapter deals with a combined crystal and valve receiver intended to operate on waves from 250 to 8,000 metres, designed by the Bureau of Steam Engineering of the U.S. Navy Department, and known as the "Destroyer Type." The circuits are of the usual loose-coupled form, with a six-step aerial inductance and series condenser for the primary, and a secondary coupling coil, six-step inductance and shunt tuning condenser in the secondary circuit. One-half of the condenser dials are divided into 180 degree scales, and the other halves are used for wavelength calibrations. An interesting feature is that as the inductance switches are taken from one stud to another, pointers on the calibration scales of the condensers move to corresponding arcs on the dials. The six separate arcs on each condenser dial can thus be ready without risk of confusion. Vernier adjustment of the condensers is brought about by turning small wheels which bear upon the dial edges.

Dead-end effects on the six-stud inductances are obviated by using four contact fingers which short circuit the unused parts of the coils. The filament resistances are made up of resistance wire wound zig-zag fashion between brass pins set into the peripheries of two bakelite discs. A switch arm runs over the set of pins nearest the panel, thus giving the necessary variation. The reaction coil (or "tickler" as it is called over the water) is made in rather an unusual way, being partly a fixed coil wound on the same former as the secondary in-

* How to Make Commercial Type Radio Apparatus." By M. B. Sleeper. (New York: *The Norman Henley Publishing Co.* 1922 Edition, 75 cents.)

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ductance, and partly a coil on a separate movable former. The condenser shunted across the H.T. battery and telephones is variable in six steps up to 0·007 mfd.

The above points have been selected for mention from one chapter alone, with the idea of giving the reader an indication of the value of the book to the serious experimenter. Other chapters contain just as many suggestive and interesting ideas. Chapter two deals with an American receiver designed for use on French ships with the well-known French valves. The chapter concludes with the following note :—

> "The outstanding feature of French and English instruments is the amount of hand work on them—beautifully made. The trouble is, however, that there is so often the same delicacy of design. American equipment, on the other hand, gains in many cases because due allowances are made for quantity production and the ruggedness required, particularly for the Army and Navy. Although foreign apparatus often calls for commendation of workmanship, it seldom equalled our own recent developments under the severe test of war conditions. In the illustrations . . . . the standard French tube, also used by the English, can be seen. . . . This tube requires only 40 volts, though transmitting tubes of this type of construction operate at as high as 750 volts. Either sort do not come up to the VT1 or VT2 of the Signal Corps."

We rather fancy Mr. Paul Godley held views like this until he came here last winter. We hope it will not be long before Mr. Sleeper awakes.

In Chapter three the Grebe Long-Wave Receiver is described with the same thoroughness which characterises the other chapters.

Other chapters in the receiver section deal with a uni-control receiver in which continuous searching is automatically carried out by the slow rotation of the tuning handle by an electric motor, an audion control box, and a two-step amplifier (L.F.). The transmitting section contains a detailed description of a recently designed Duplex Radiotelephone set made by the Western Electric Company for the Navy and other interesting apparatus, including some notes regarding the English Marconi apparatus. The aeroplane section is equally instructive. In the miscellaneous equipment section one of the most interesting portions is the description of the Eaton Oscillator, a device which can be connected to an ordinary loose coupler, tuning condenser and valve so that it can be used for C.W. reception for any wavelength between 200 metres and 25,000 without any additional adjustments. In the same section is also included a description of the Bureau of Standards Long-Wave Wavemeter for waves from 1,500 to 22,000 metres.

Unfortunately, the book lacks an index, which, in view of the many practical and important matters discussed in it, is a drawback to the experimenter. The photographic illustrations are also badly reproduced. However, these are minor criticisms in an otherwise very valuable and well-written book, which every amateur constructor (and many a professional as well) should add to his bookshelf.

P. W. H.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with interest the recent correspondence on jamming with valve receivers.

I am afraid it is hopeless to ask all amateurs to use separate heterodyne or to make their sets as little nuisance as possible. People are not made that way ; as long as they cannot be found out they will still carry on.

But are even experienced amateurs free from blame ? A recent letter in *The Wireless World* reads :—

> "Immediately one got the set off the oscillation point and was receiving the concert nicely, in would come a terrific howl . . . . and set the whole apparatus oscillating strongly again."

Was there ever a clearer case of "giving the show away ? "

J. W. W. WHITESIDE (2 JO).

Clitheroe, Lancs.

# Calendar of Current Events

**Saturday, July 1st.**

CROYDON WIRELESS AND PHYSICAL SOCIETY.
Ordinary Meeting.

**Sunday, July 2nd.**

Transmission of Telephony from 3 to 5 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, July 3rd.**

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.
7.30 *p.m.*—Annual General Meeting and election of President and officers.

**Tuesday, July 4th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT** Writtle, near Chelmsford.

**Wednesday, July 5th.**

FOLKESTONE AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At Cave's Café, Sandgate Road. Weekly Meeting.

ILKLEY AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At the "Regent Café," Cowpasture Road, Ilkley. Committee Meeting.
8 *p.m.*—Lecture and demonstration on "Short Wave Telephony Reception."

**Sunday, July 9th.**

Transmission of Telephony at 3 to 5 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, July 10th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.
7.30 *p.m.*—Annual Meeting for election of officers.

**Tuesday, July 11th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT** Writtle, near Chelmsford.

**Friday, July 14th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—Lecture on "Maritime Radio Communication," by Mr. D. E. Pettigrew.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

WIRELESS SOCIETY OF LONDON.

The Forty-ninth Ordinary General Meeting was held on Wednesday, June 14th, at the Institution of Electrical Engineers, at 6 p.m.

After the minutes of the previous meeting had been approved and signed, the President called upon Sir Oliver Lodge to give his address.* Ballot papers, which had been circulated, were collected at the end of the meeting. The President announced that the new members had been duly elected, and that that meeting closed the session.

### The West London Wireless and Experimental Association.*

Club Rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

Meeting held Thursday, June 8th. :—

A very interesting gathering assembled to listen to a very instructive lecture by Mr. J. F. Turner, of the M.O. Valve Co., entitled the "Theory of the Thermionic Valve." The lecturer dealt with his subject in an elementary form, and remarked that to understand the inner mysteries of the valve one had to, according to present-day theory, bring in the electron.

The electron was briefly explained and its properties were outlined and with the aid of diagrams, projected by a lantern, a good deal of the "inner mysteries" were made more comprehensive. In turn the lecturer dealt with the composition of the filament, the grid, and the anode, also the bulb, and the pumping of the bulb. Questions were invited and the lecturer replied very fully. A very hearty vote of thanks was accorded Mr. Turner on completion of his lecture and all present were invited to inspect the large number of specimens of various types of valves which were exhibited.

The Secretary desires to point out that all members will receive a copy of the Additional and Amended Rules in due course, and, further, any gentlemen who feel interested in radio telegraphy and are going in for "broadcasting" sets, should endeavour to join a society in that neighbourhood which will give them most valuable help in their launching out into the mysteries of the æther. All applications for membership and terms of subscriptions, together with objects of this Association, will be immediately replied to by the Secretary.

### Folkestone and District Wireless Society.*

Hon. Secretary, Mr. H. Alec S. Gothard, Associate I.R.E., 8, Longford Terrace, Folkestone.

Arrangements are being made to hold weekly meetings, in a private room at Cave's Café, Sandgate Road, throughout the summer months.

The first meeting will be held at 7.30 p.m., on Wednesday, July 5th. Old members are particularly requested to be present. Those seriously interested in the science of radio telegraphy and telephony are cordially invited.

Full particulars of the Society may be obtained on application to the Hon. Secretary.

### Newcastle and District Amateur Wireless Association.*

The Annual General Meeting for election of President and Officers will take place on Monday, July 3rd, at 7.30 p.m.

Country and intending new members should make an endeavour to be present.

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane Heaton, Bradford.

Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the club-room at 7.45 p.m., on Friday, June 16th, with Mr. W. C. Ramshaw in the Chair. The minutes of the previous meeting were read and passed, following which a few new members were elected.

The Chairman then called upon Mr. J. Bever to give his lecture on "General Wireless Matters." This consisted in the main of a description of his own four-valve set, and was extremely interesting. During the course of his remarks Mr. Bever made several references to the increasing number of people using valve sets, who not having the necessary knowledge to operate them cause interference by allowing their apparatus to oscillate unnecessarily. Mr. Bever's set was on view, and is a very well made piece of apparatus, fitting, as it does, in a moderate sized attaché case. The set was connected to the Society's aerial and excellent signals were obtained on short wave, including telephony from a local station. These signals were easily readable with the telephones lying on the table, at the other end of the meeting room.

At the conclusion a hearty vote of thanks was passed.

The meeting on June 30th concluded the session but the Committee have decided to continue the fortnightly meetings throughout the recess, when short elementary lectures and discussions will be given for the benefit of new members. Morse practices will also be held.

The Chairman made an announcement urging all new members desirous of purchasing apparatus to consult members of the Committee before deciding

* The address by Sir Oliver J. Lodge appears on p. 407 of this issue.

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on what to buy, in view of the fact that there is a considerable amount of junk gear being placed on the market at the present time.

### Stoke-on-Trent Wireless and Experimental Society.*

On Thursday, June 15th, J. Gaskell, Esq. (Assistant Hon. Secretary), gave a lecture and demonstration on X-rays. Questions were asked and answered regarding the relation of X-ray waves to wireless waves, and remarks were made concerning the similarity between the X-ray tube and the thermionic tube used in wireless communication. A vote of thanks was heartily accorded to the lecturer, the Chairman expressing a wish that in the coming session they would have the pleasure of hearing Mr. Gaskell again.

A corresponding members section has been opened for members unable to attend the ordinary meetings, and a technical committee has been formed to deal with questions put forward by them.

Those interested should communicate with the Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley, Stoke-on-Trent.

### Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

The second of the series of elementary lectures on wireless was given at the Highgate Literary and Scientific Institution on Friday evening, June 16th, by Mr. J. Stanley, B.Sc., A.C.G.I., to an audience which again comprised a large number of visitors, including several ladies.

Mr. Stanley went briefly over the theory of the ether, showing that it possesses the properties essential for wave motion—elasticity and inertia—and then took his hearers carefully over the important subject of wave-motion generally, showing exactly what is meant by wavelength and frequency. He illustrated his remarks by analogies derived from the action of water waves, and led up to the fundamental equation for all wave motion, *i.e.*, velocity = frequency × wavelength. He then took up the question of oscillating current, showing how these could be produced by the discharge of a condenser through a circuit containing inductance, and how trains of oscillatory discharges could be produced by the inclusion of a spark gap in such a circuit.

The lecturer followed on by showing what was meant by the "impedance" of a circuit, and gave the formula for this quality, and went on to point out how it followed from this that the wavelength of a circuit was dependent upon the inductance and capacity in that circuit.

Finally, he showed how by application of oscillating currents to open radiating circuits such as ordinary wireless aerials, electro-magnetic waves were set up in the ether and sent out into space, and he showed the different forms of aerials affected the shape of the waves produced and the directional properties of the aerials.

Mr. Stanley's remarks were illustrated throughout by excellent diagrams thrown on the screen, and this added considerably to the interest and clearness of the lecture.

At the conclusion a very hearty vote of thanks was given to Mr. Stanley, and the meeting was adjourned. Seven new members were elected, and five further applications for membership were received.

The Hon. Secretary would be pleased to hear from anyone interested, and to give further particulars of the Society. The Society has made arrangements to receive the Marconi concert at the Highgate Literary and Scientific Institution on Tuesdays, at 8 p.m., during June and July and anyone interested will be welcome on these occasions.

### The Wireless Society of Hull and District.*

On June 12th, before a large attendance of members, Mr. W. J. Featherstone, who was one of the pioneers in wireless in Hull, read a most interesting paper on miscellaneous topics dealing with wireless. For the benefit of the new members he gave an account of the various detectors (past and present) such as the coherer, magnetic, crystal and valve. He also exhibited a relay and explained by the aid of diagrams the various uses to which it could be put. The lecturer related many incidents which had happened since he first took up wireless work, and altogether a very interesting evening was spent.

Mr. G. H. Strong, President, was in the Chair, and in the course of a few remarks, in which he welcomed the new members, he sounded a note of warning and told them that they must not expect too much from the crystal detector as regards receiving telephony. He mentioned that in view of the many cheap crystal sets which are being placed on the market just now. He proposed a vote of thanks to the lecturer and this was ably seconded by Mr. C. Dyson (another pioneer of wireless in Hull).

Fourteen new members were elected. A number of books on wireless subjects have been given by different members, and the whole question of the formation of a library has been relegated to a small sub-committee, to draw up suitable rules, etc. Members who are willing to give books for this purpose should communicate with the Hon. Secretary. Members should note that "The Wireless Year Book for 1922" can be consulted at the Central Free Library (Reference Dept.).

The annual meeting for the election of officers, and other business, will be held on Monday, July 10, at 7.30 p.m. The remainder of the evening will be occupied by questions and answers, which should prove very helpful to the new members. It is hoped that there will be a large attendance on this occasion.

Meetings of the Society are held at the Signa Corps Headquarters in Park Street, on the second Monday in each month.

Intending members should apply to the Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull, who will supply full particulars.

### North Middlesex Wireless Club*.

The 93rd meeting of the Club was held on Wednesday, June 14th, at Shaftesbury Hall, Bowes Park, N. The Chair was taken by the President, Mr. A. G. Arthur, and after the minutes had been read, the Secretary, Mr. E. M. Savage, announced that it had been arranged to hold elementary classes for beginners, commencing at 7.30 on ordinary meeting nights, for one hour. Will all those interested please make a note of this for next meeting on June 28th.

The Chairman then called on Mr. L. C. Holton to read his paper on "The Townsend Wavemeter and How to Use It."

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Mr. Holton commenced by explaining how waves were produced in water, and compared these with those produced in the ether in wireless work. He made clear to beginners that wavelength is independent of range of transmission. He also explained the meaning of the terms frequency and amplitude. The wavemeter was used in a number of ways, but one of its chief uses was to measure the incoming waves at a receiving station. The lecturer gave a demonstration of this, and explained how to use the charts supplied with the meter.

This wavemeter is the property of the Club, and has been calibrated by the National Physical Laboratory at considerable cost, so that its accuracy is to be depended upon. It is available for the use of members under the Club's Loan Scheme.

A vote of thanks was moved from the Chair at the close of Mr. Holton's lecture.

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

### The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

The twenty-first meeting of the present session was held on Thursday, June 14th. Mr. S. J. Martin in the Chair.

The lecturer for the evening having met with an accident, Mr. Martin offered to fill the gap caused by his absence and gave a most interesting lecture on "The Construction and Theory of Valve Receivers."

On the termination of the lecture a general discussion was opened, during which the question of the reception of the telephony from the proposed Manchester broadcasting station was brought forward. The Society stated their opinion that the music should be received quite well in Liverpool on a crystal set, provided that the power of 1½ kW. is used, the Society are also of the opinion that two or three valves will receive the telephony from most of the broadcasting stations in the kingdom.

The above may be of use to the many amateurs in the district who wish to construct a set. The Society would like to ask the users of valve sets in the district to avoid, as far as possible, excessive radiation during the reception of the Bar Ship telephony, and the concerts on Sunday morning.

On Sunday last 15 radiation waves were detected by one of the members. The Society would like to advise offenders in this respect that a direction finding set is under construction; it is intended to find, as far as possible, the culprits, and to take the necessary steps to prevent the disturbances.

### Sheffield and District Wireless Society.*

On and after June 23rd the address of the Hon. Secretary of the above Society will be 18, Linden Avenue, Woodseats, Sheffield.

### The Wireless and Experimental Association.*

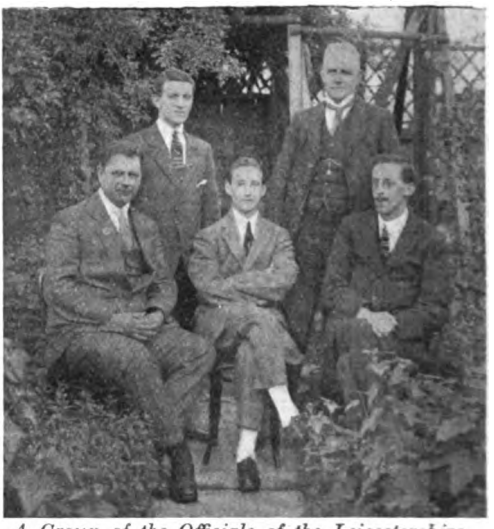
A very busy evening was spent on Wednesday, June 7th, deciding what arrangements were best for our forthcoming public demonstration. Many members volunteered to bring along apparatus for show and demonstration, and some well-known transmitting stations are providing a special programme. It is hoped that the President, Mr. Wm. Le Queux, will be present on that occasion, and a very varied and interesting programme has been prepared so as to give the public a true idea of the possibilities of wireless broadcasting.

Although the membership list is steadily increasing, there are a few rows of seats available for any who care to take up the study of wireless.

Final arrangements for the public demonstration on June 22nd were made. Marconi's had promised to supply a short programme, and the members looked forward to a very successful broadcast of the advantages of wireless, either as a hobby or study. The Chairman gave a very lucid description of how to determine the sensitiveness of receiver required for the reception of signals from predetermined stations, taking into account local conditions and power of transmitter. One of the members having come down from the meeting of the Wireless Society of London was able to pass on some of the information so ably put forward by Sir Oliver Lodge.

Those requiring information should communicate with the Assistant Secretary Mr. W. J. Joughin, 21, Troughton Road, Charlton, S.E.7.

### Leicestershire Radio Society.



*A Group of the Officials of the Leicestershire Radio Society.*

Standing: Mr. L. Pratt, Mr. D. Morton. Sitting: Mr. J. Rudkin (Treasurer), Mr. C. T. Atkinson (President), Mr. J. R. Crawley (Hon. Sec.)

### Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A meeting of the above Association was held on May 25th at 7.30 p.m., Room 74, Mechanics' Institute. We had the pleasure of listening to an interesting talk on wireless telephony by Mr. Gosling. In view of the interest taken at the present time in the proposed broadcasting schemes, the subject chosen was very appropriate. Mr. Gosling dealt with the evolution of wireless telephony from the first experiments, and explained the various methods employed in this class of transmission. The lecturer also gave hints on the best methods for receiving telephonic communications. The usual discussion on the lecture ensued.

During the summer months meetings will be held monthly, the dates being:—June 29th, July 27th, August 31st, September 28th.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"CONTACT STUD" (Rotherham)** *asks with regard to the Reinartz Tuner (1) For a diagram of circuit adapted for three valves. (2) Could the Broadcast signals be heard with this circuit and the loud speaker at a distance of about 80 miles. (3) Is the length of a receiving aerial still restricted to 100 ft. (4) Will the Reinartz Tuner tune to any wavelength by means of external coils.*

(1) We have no information on a modification of this set in this way, but think the scheme outlined in the diagram should be satisfactory. (2) We doubt if sufficient strength for a loud speaker would be obtained at this distance. (3) We believe that the restrictions are still enforced, but the requirements of the P.M.G. are not finally decided as yet. (4) Yes, up to reasonably high values of wavelengths. We should not recommend this circuit for very long wavelengths above, say, 5,000 metres.

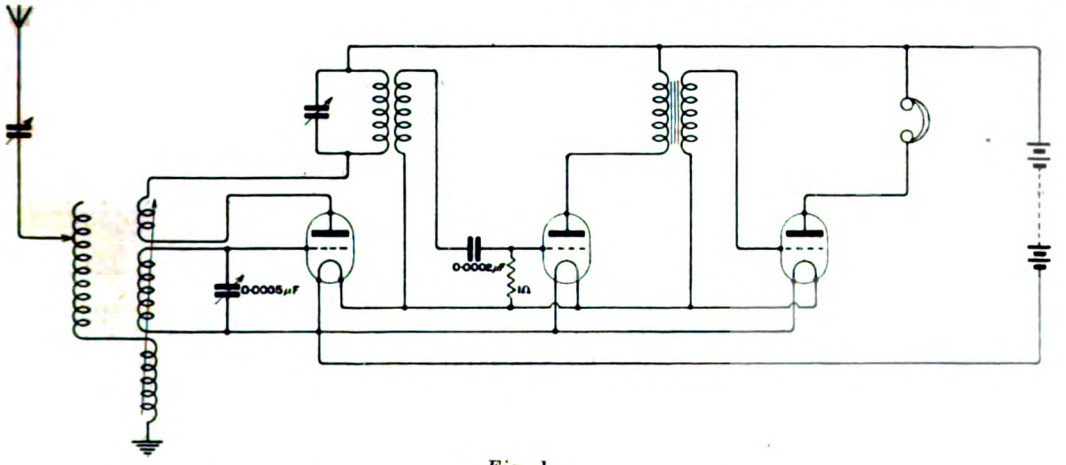


*Fig. 1.*

**"J.E.L." (Letchworth)** *asks (1) for a circuit for connecting up certain apparatus to form a three valve set. (2) The range of the set.*

(1) See diagram, Fig 1. (2) Maximum wavelength approximately 3,000 metres.

**"J.W.C." (Loughborough)** *has a three-valve receiving set on which he gets C.W. and spark, but cannot get telephony. He asks (1) Why. (2) How to remedy howling. (3) Should he be able to receive the Hague Concerts with a four-wire aerial, 30 ft. long and 26 ft. high. (4) Is the four-wire aerial connected up correctly.*

(1) Set should give 2 MT. A 43 turn coil is too small with a series tuning condenser. Use about 100 turns. (2) Howling is probably due to strong fields from your L.F. transformers. Try separating them more, or screening them from each other. Also try less reaction. Try the A.T.C. on the aerial side of the A.T.I. (3) Doubtful, without some H.F. amplification. (4) It is better not to cross-connect the wires at the free end.

**"M.F.G." (Manchester)** *asks (1) Is a circuit sketched correct. (2) Will the two-valve resistance coupled circuit on page 12 of Mr. A.M. L. Douglas' book receive signals from America and the Dutch Concerts. (3) The gauge of an enclosed specimen of wire, and is it any use for construction of wireless apparatus. (4) Can basket coils be put in series with the solenoid inductance to increase the wavelength.*

(1) The circuit is correct, but you would get better results with more turns on the inductance and less parallel capacity. (2) It should do so,



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provided that the inductances and capacities in the circuits are suitable for tuning in the stations required. (3) No. 30. It might be used for closed circuit and reaction coils, short wave L.F. transformers and similar purposes. (4) Yes.

**"G.S.F.B." (Hampstead)** *asks with reference to Reinartz Tuner described in the issue of May 13th (1) If certain modifications would make it suitable for 700 metres without additional coils. (2) What tappings would be necessary. (3) What tappings for reaction coil. (4) How to add a stage of H.F. amplification.*

(1) We cannot give exact valves without experimental work which you can equally carry out yourself, but we think your suggestion of a former 3½" diameter with 25 turns for the aerial, and 50 for the grid circuit, should be satisfactory (2) Try tapping the grid coil at 20, 30, 40 and 50. Tap the aerial coil at every two turns. (3) Reaction coil might have 35 turns, tapped at 10 and 20. (4) See diagram, Fig. 2.

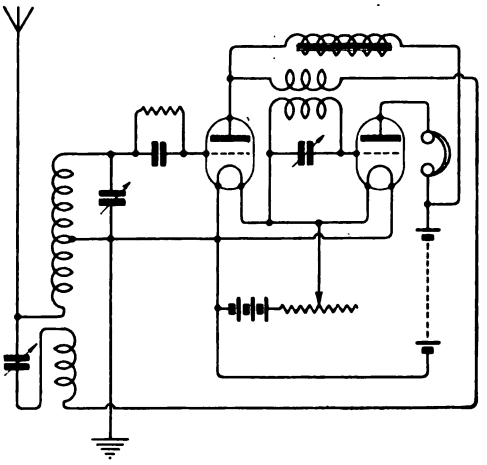

*Fig. 2.*

**"O.J.L." (Euston Road)** *asks how to add a valve to his set of which he encloses a diagram.*

It is difficult to advise you with any certainty without a knowledge of the internal connections of your set, but the addition of an L.F. valve, as in the diagram, would probably be satisfactory.

**"ANDREAE COLLEGIUM" (Bradfield)** *asks (1) How to add another valve through a resistance capacity to a circuit sketched, so that he can switch over quickly from one valve to two. (2) Whether English broadcasting stations could be heard on one valve at Rouen.*

(1) Use a spherical reaction coil. Preferably couple the switch shown with a switch to break the filament of the second valve (as shown) when not required, and use separate filament resistances for each valve. (2) Very doubtful.

**"LUX" (Greenock)** *asks (1) For a diagram of a two-valve set. (2) If the Broadcasting Stations would be audible at 23 and 70 miles with crystal set and a single valve set respectively. (3) If an aerial 25 ft. high at one end and 35 ft. at the other would give as good results as an aerial parallel to the ground*

(1) See diagram, Fig. 3. More than one H.F. transformer would be necessary for as big a range as 150/5,000 metres. (2) Weak but readable signals should be obtained at 23 miles with a crystal set. Similar results *might* be obtained at 70 miles with a single valve set, but only if critical reaction were used. (3) Yes, if the height of the level aerial were about 30 ft.

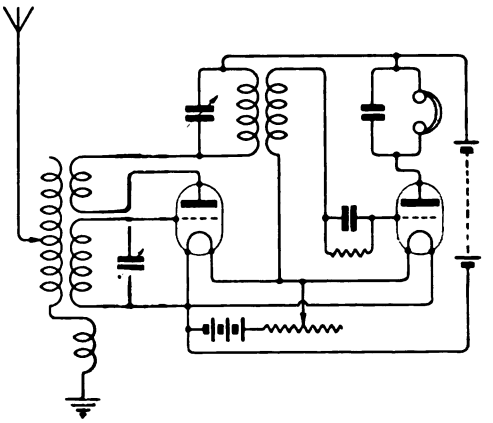

*Fig. 3.*

**——— (South Norwood)** *asks (1) Why he gets "howling" when the condenser is put in series with the aerial and coil. (2) How to wind an inductance to cover a range of from 180/600 metres when shunted by a condenser of 0·001 mfd. (3) How could the "howling" be prevented. (4) Is it possible to get PCGG on the above set.*

(1) and (3) At is impossible to give reasons as you neither describe nor sketch your set. It may perhaps be due to the leads being crowded too closely together. The howl may possibly be just induction from the A.C. supply. (2) Results would be very poor as suggested. Put the condenser in series with the A.T.I. which should be 3" × 4" of No. 24, with say, three taps. Reaction coil 3" × 2" of No. 24. (4) We cannot say without seeing a circuit diagram, which should be possible with a well laid out set.

**"A.B.C." (Sheffield)** *has bought a loud speaker which will not work on his set, of which he encloses a diagram.*

You give us very little information about your loud speaker, but the reason for its bad performance is probably that its resistance is unsuitable. For your set the speaker should have a high resistance. The one you possess is probably low. If so, you should use it with a transformer. A standard telephone transformer will be all right if the resistance of the speaker is about 100 ohms.

**"VINCAM" (Framlingham)** *asks if a list of instruments he gives will enable him to receive music and speech from Holland. (2) If they are correctly wired in his diagram. (3) Suggestions for alterations*

(1) PCGG should be obtainable in Suffolk on a single valve set of good type skilfully used. (2) and (3) The type of circuit suggested is quite useless. Your circuit might be on the lines of that shown in Fig. 4, page 372, June 17th.

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**"A.R.O.S." (Paris)** *asks* (1) *For diagram of circuit for a reliable four-valve set, with range between 400 and 500 metres.* (2) *Would this circuit receive weak signals on 440 metres with Eiffel Tower transmitting on damped waves at the same time 8 miles away.*

(1) See diagram, Fig. 6. We do not know of an Army pattern double slide tuning coil. (2) Crystal detectors cannot be used with indoor frame aerials. (3) Range depends upon the transmitting station and aerial dimensions. You should receive all the European high power spark stations, also some ship and coast stations and London telephony transmitted with large power.

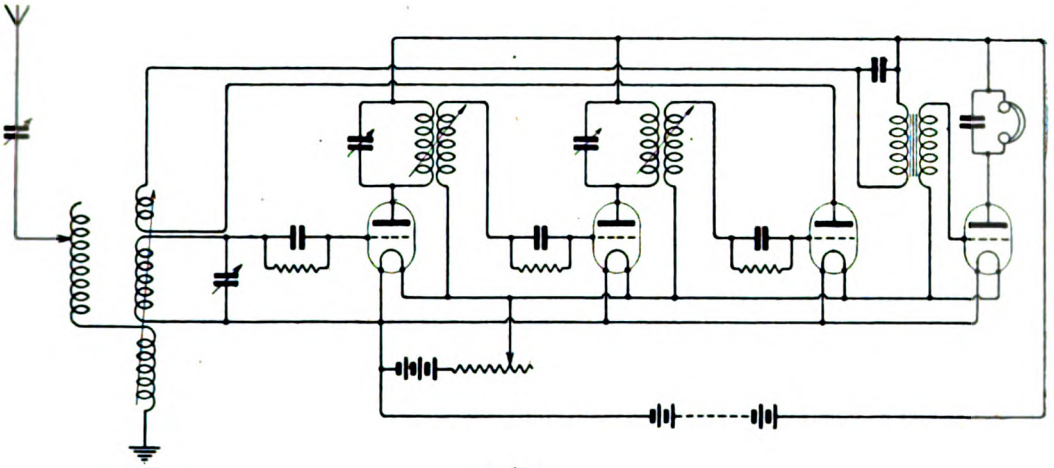

*Fig.* 4.

(1) See diagram, Fig. 4. (2) It is difficult to say without test. You will probably have considerable difficulty, but this is about the best you can do with any ordinary method.

**"C.L." (Malvern)** *sends a diagram of his set and asks* (1) *Whether the condenser should be as shown or across the reaction coil.* (2) *Whether 50 volt H.T. is sufficient for good results.* (3) *The best way to add one stage of L.F. to the set.* (4) *The cost of doing this.*

(1) Condenser is best as shown in your diagram. (2) Yes. (3) See the amended diagram, Fig. 5. (4) About 35s. to 50s.

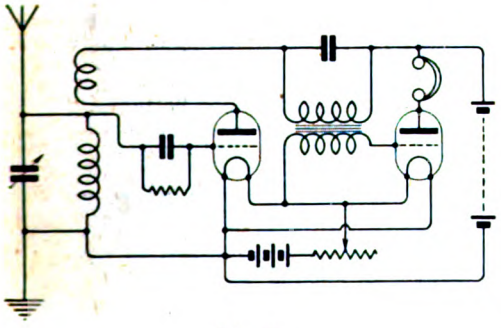

*Fig.* 5.

**"HAVANA" (Ealing Common)** *wishes to know* (1) *The best method for connecting up a two-slide tuning coil, variable condenser, galena detector and fixed telephone condenser* (2) *Whether such apparatus can be operated from a frame aerial.* (3) *Receiving range.*

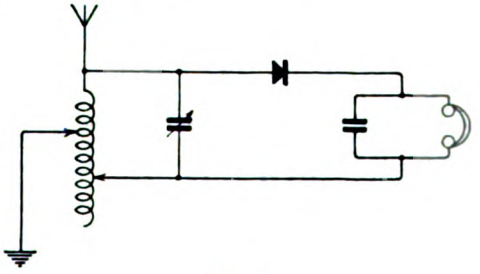

*Fig.* 6.

**"J.W." (Eglington)** *asks* (1) *What kind of a set he would require to receive Broadcasting Stations in England.* (2) *For a diagram for erecting an aerial.*

(1) For good results you will probably require a three-valve set, preferably with one stage of H.F. amplification, one detector and one L.F. amplification. (2) Many types of aerial are possible. The main points are (*a*) to use as great a length as possible up to the 100 ft. allowed. (*b*) insulate the wire from all supports, and keep it as far as possible from buildings; (*c*) avoid sharp bends in the wire; (*d*) erect the wires as high as possible.

**"DE RESKE" (Ashfield)** *asks for circuit comprising 1 H.F., 1 rectifying and 2 L.F. valves with magnetic reaction and transformer coupled and having switches arranged for using either first two valves shown or all four valves.*

See circuit Fig. 7.

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**"RADIO" (Bolton-on-Dearne)** *sends diagram of a circuit given in "The Wireless World" of December 11th, 1920, and asks with regard to it (1) Length and gauge of wire for the aerial. (2) Gauge and number of turns for the inductance. (3) If a condenser of 0·0015 mfds. would be suitable.*

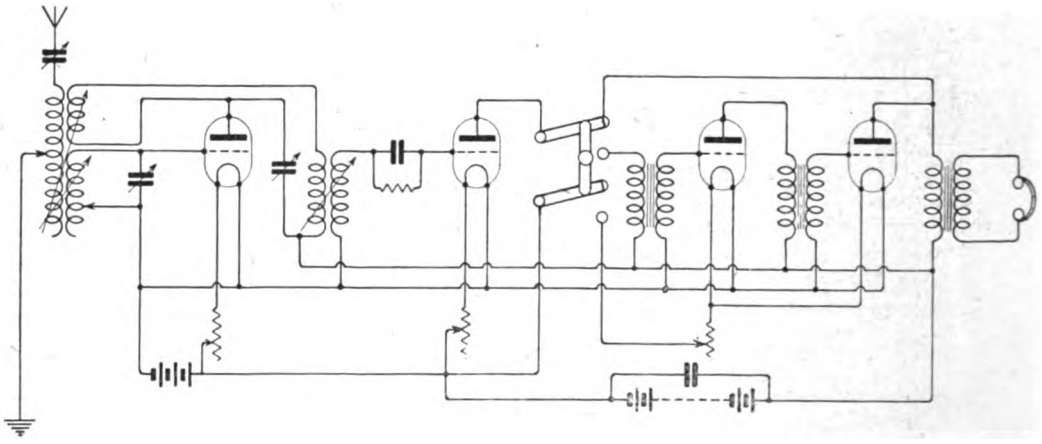

*Fig. 7.*

(1) The aerial might be 7/26 or 3/22 cable, or of No. 16 or 18 phosphor bronze wire. The length should be as great as possible up to the maximum of 100 ft. allowed by the P.M.G., and height as great as possible. (2) Wind a former 8″ × 6″ with a single layer of No. 24 wire, fitting it with a slider or number of tappings. (3) Suitable for a series A.T.C. If used as a shunt condenser, capacity is rather high and the setting should therefore be kept as near maximum as possible.

**"W.E.N." (East Finchley)** *sends diagram of a three valve receiving set and asks (1) Wavelength of a certain circuit. (2) Criticism of enclosed circuit. (3) Wavelength of the whole set. (4) How should the set be altered so as to receive short wave signals.*

(1) The inductance would be 1,200 mhys. The wavelength will, of course, depend upon how it is used. It could be used for $L_1$, but will not give very great increase of wavelength if L is fairly large. Your reaction coil is wrongly connected. Put it in series with anode circuit of the valve. The telephone transformer should be iron core. C.2 equals 0·0005 mfds. (3) This depends entirely upon L, about which you say nothing. (4) By putting the A.T.C. in series with the A.T.I., instead of in parallel with it.

**"OPTIMIST" (Orrall Park).** *With regard to a two-valve circuit described in the issue of May 28th, 1921, he asks (1) The size of former for L.2 to reach* **PCGG**, *with tappings for 300, 600 and 1,070 metres. (2) Dimensions for a reaction coil to rotate inside L.2. (3) Values for grid condenser and leak. (4) If* **PCGG** *would be heard on this set.*

(1) Coil should be 4″ × 4″ of No. 24 with tappings at 1″ and 2½″. (2) 3″ × 3″ of No. 24 should be sufficient. (3) 0·0002 mfds. and 3 meghoms. (4) Yes. N.B.—This circuit is liable to give serious re-radiation trouble.

**"F.C." (Nelson)** *has constructed a three-valve set as described in the issue of April 8th, on which he can get no telephony. He asks why.*

The set shown is of very good type. Failure to get telephony is probably due to there being none within reasonable distance. Also a set of this type generally needs much patient adjustment to work it up to its maximum sensitivity. An alternative multi-valve arrangement, which is possibly of somewhat simpler type, is given on page 368, June 17th issue, which need not of course be used with a frame aerial.

**"E.M.B." (Penarth)** *has a receiving set made on the lines of that given in the issue of February 18th. He asks (1) Will the set receive telephony with slab coils, including* **PCGG**. *(2) Can he make any improvement in the circuit to make telephony clearer. (3) What resistance telephones are most suitable for the circuit. (4) Can a reactance condenser be used in the circuit instead of a coil.*

(1) It is very unlikely to receive **PCGG** in Wales. The range on Broadcasting transmission is possibly 50 miles. (2) No, except possibly with the addition of a grid condenser and leak, or additional valves. (3) 8,000 ohms, but either 4,000 or 2,000 ohms will give quite good results. (4) Yes, but we doubt if this would be an improvement, either as regards results or ease of handling.

## SHARE MARKET REPORT

Prices as we go to press on June 23rd, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 10 | 0 |
| ,, Preference .. .. | 2 | 5 | 0 |
| ,, Inter. Marine.. .. | 1 | 12 | 0 |
| ,, Canadian .. .. | | 11 | 0 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 15 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 15. JULY 8TH, 1922 WEEKLY

## Berne Radio Station

### A DESCRIPTION OF THE TRANSMITTING APPARATUS OF THE NEW SWISS INSTALLATION.

As in most modern wireless stations the general arrangement is one of "central control." This system allows of direct duplex communication from one large centre to another, when from technical and other reasons the transmitting and receiving stations are situated some distance from such a centre: this arrangement also facilitates the handling of traffic. In the case of the Berne Station the control or operating office is contained in the main post office in the Swiss capital.

The transmitting station is situated on a plateau about 1,800 feet above sea level on the outskirts of the village of Munchenbuchsee. A good idea of the site and surrounding country can be seen from Figs. 1 & 2 which give a general idea of the station.

The transmitting and receiving stations are located some 10 kilometres North and 5 kilometres West of Berne respectively.

The transmitter is a coupled circuit Marconi valve set, employing 12 MT6 three-electrode valves in parallel and a total input of 25 kW. The electric supply for the station is taken from the Berne Power Supply Company at 16,000 volts 3 phase 50 cycles, transformed down to 500 volts at a sub.

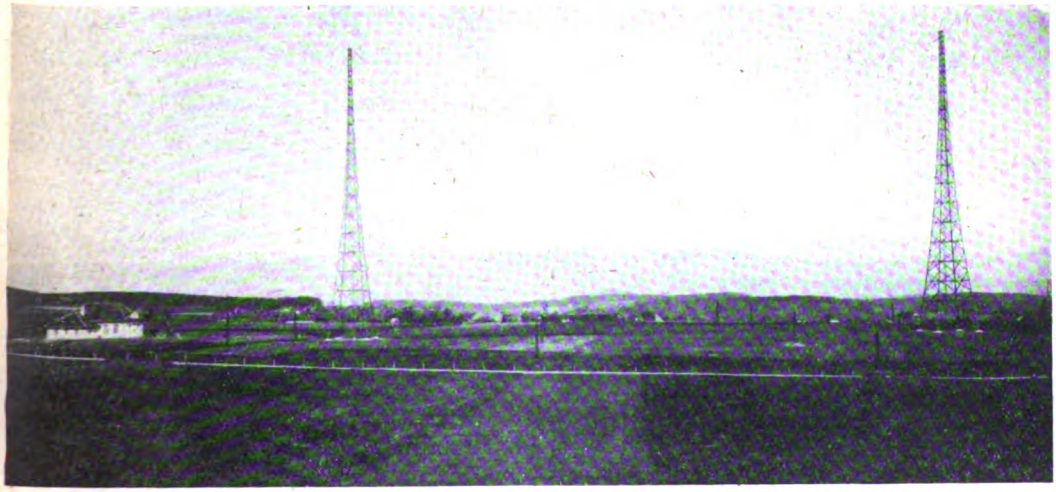

*Fig.* 1. *Transmitting Station on the Plateau at Munchenbuchsee.*

transformer station, and brought in on to the main switchboard by underground cable.

The necessary H.T. D.C. voltage for the anodes of the oscillating valves is obtained by double rectifying the three phase supply by means of 12 two-electrode valves, type MR6. For this purpose the main supply is led in to the primaries of three transformers, the windings of which are delta connected. The secondaries are star connected, the

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end of each winding being connected to the plates of 2 valves and the D.C. output taken from the filament circuit and the mid-point, see Fig. 3.

The characteristic of this three-phase double rectification is that the resultant consists of about 90 per cent. D.C. component plus 10 per cent. ripple of six times the original frequency; very little filtering is necessary to transform it into a constant D.C. supply.

The connections of the oscillating valves is the usual top feed arrangement and the general scheme of connections of the oscillating circuit shown in Fig. 4.

As will be seen from Fig. 4, a separate anode tap coil coupled to the closed circuit inductance is used; this arrangement on medium power is more satisfactory and also simplifies the design of the main inductance. The closed circuit is completed

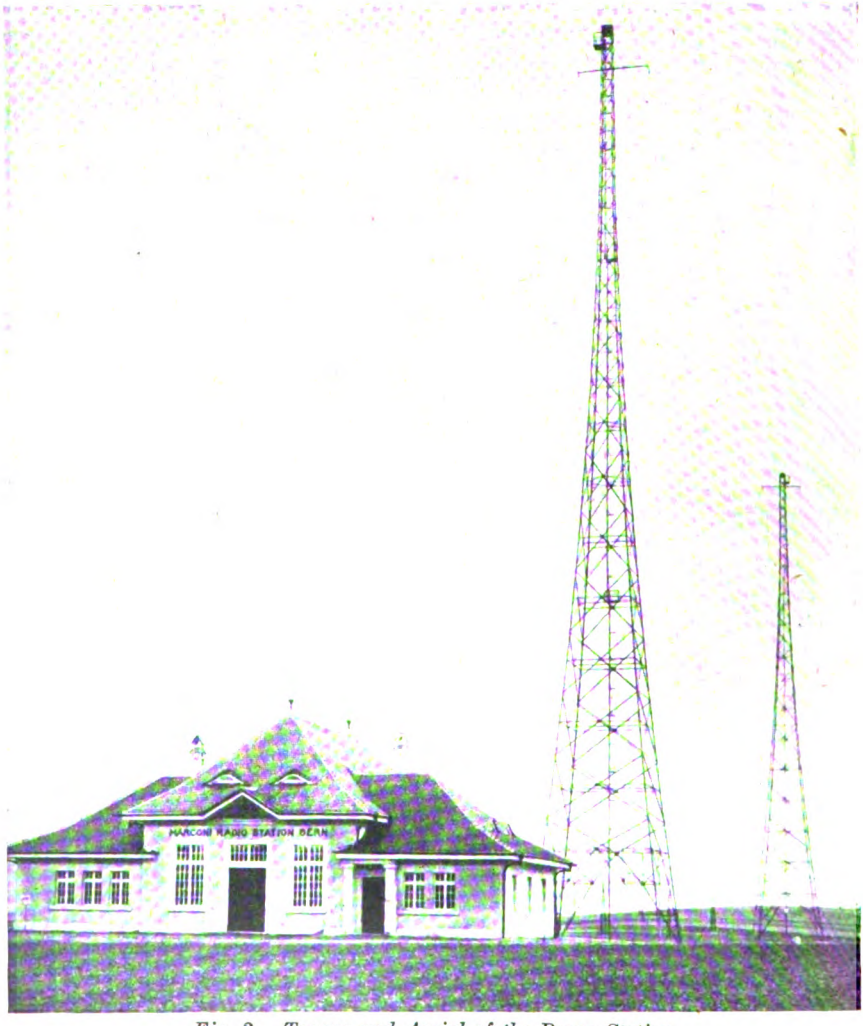


*Fig. 2. Towers and Aerial of the Berne Station.*

The primary power input can be varied from 8 kW. to full power by means of variable iron core chokes, one being connected in each phase and capable of synchronous adjustment. The lighting of the rectifier and oscillating valve filaments is accomplished by transforming the three-phase main supply into two phase by means of a "Scott" connected transformer, one phase each being used for the oscillator and rectifier filaments respectively.

through an air condenser of 0·006 mfd., and is coupled to the aerial inductance by two adjustable coils which are normally in opposition.

Control of energy to the aerial is effected by shorting or un-shorting one of these coils by means of a specially designed single contact key operated by a Creed compressed air engine.

It may be pointed out, that nowadays, if the transmitting wave can be kept absolutely constant, the

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receiving side has available circuits which greatly decrease atmospherics and other disturbances and allow the use of mechanical recording devices, such as direct printers, etc., also duplex conditions to avail irrespective of directional aerials. This is the reason why the somewhat novel method of keying described has been employed; it possesses

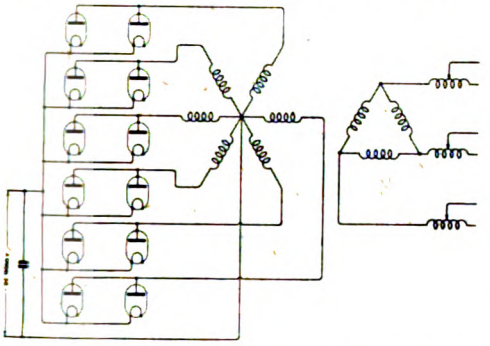

*Fig. 3. The connections of the Rectifier Circuit, giving three-phase double rectification.*

this great advantage of giving steadiness of wave without bringing in any appreciable undertone or compensation wave. It is especially applicable to high speed signalling owing to the quick cut on and off of the signal, and almost complete absence of sparking at the key contacts.

By careful design of the closed circuit the high frequency resistance has been brought down to 0.6 ohms at the normal wave of 3,400 metres, thus giving an efficient transfer of energy to the aerial circuit.

The aerial is an inverted "L" made up of two four-wire cages, carried on two self-supporting towers, each 300 ft. high, spaced 600 ft. apart, the natural period of the aerial being 1,600 metres and the capacity of 0.0042 mfd.

In accordance with the latest practice the earth coming under the influence of the aerial field is efficiently screened by means of 18 wires supported on 30 ft. lattice steel poles, and which, connected

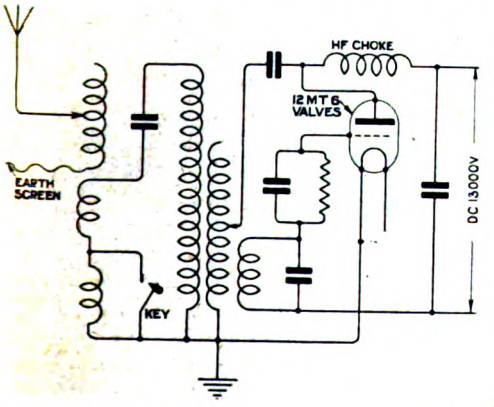


*Fig. 4. The Aerial Circuit showing signalling arrangement and also the Oscillator Valve Circuit.*

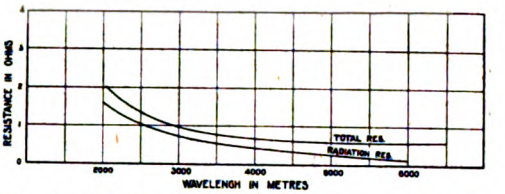


*Fig. 5. Resistance-Radiation Curves of the Aerial at Ongar.*

to the lower end of the aerial tuning inductance, form the return path of the aerial circuit.

Resistance measurements taken show the efficiency of the aerial at 3,400 metres to be of high order.

The curves of the total resistance and radiation resistance of the similar aerial at Ongar (the English end of the service) are shown in Fig. 5, plotted against wavelength.

In case of any failure from the outside source of supply a reserve power plant is installed consisting

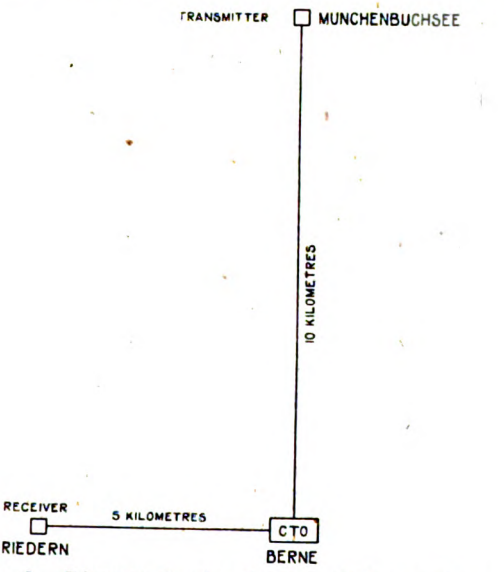


*Fig. 6. Diagram showing location of Transmitting and Receiving Stations.*

of 80 h.p. Diesel engine, driving a 50 K.V.A. three-phase generator, 500 volt 50 cycles, Fig. 7.

The necessary auxiliary machines are installed in a room adjoining the main transmitting room and consist of :—

AC/DC motor generator groups for supplying the necessary current for signalling keys and various relay circuits. Motor driven air compressors for supplying compressed air working the Creed engines, and blower motors for cooling the filament seals of the oscillating valves, and cooling key contacts. All the auxiliaries are in duplicate in case of breakdown.

The central control and operating office is on the third floor of the Berne main Post Office, and has direct telephone communication with all the

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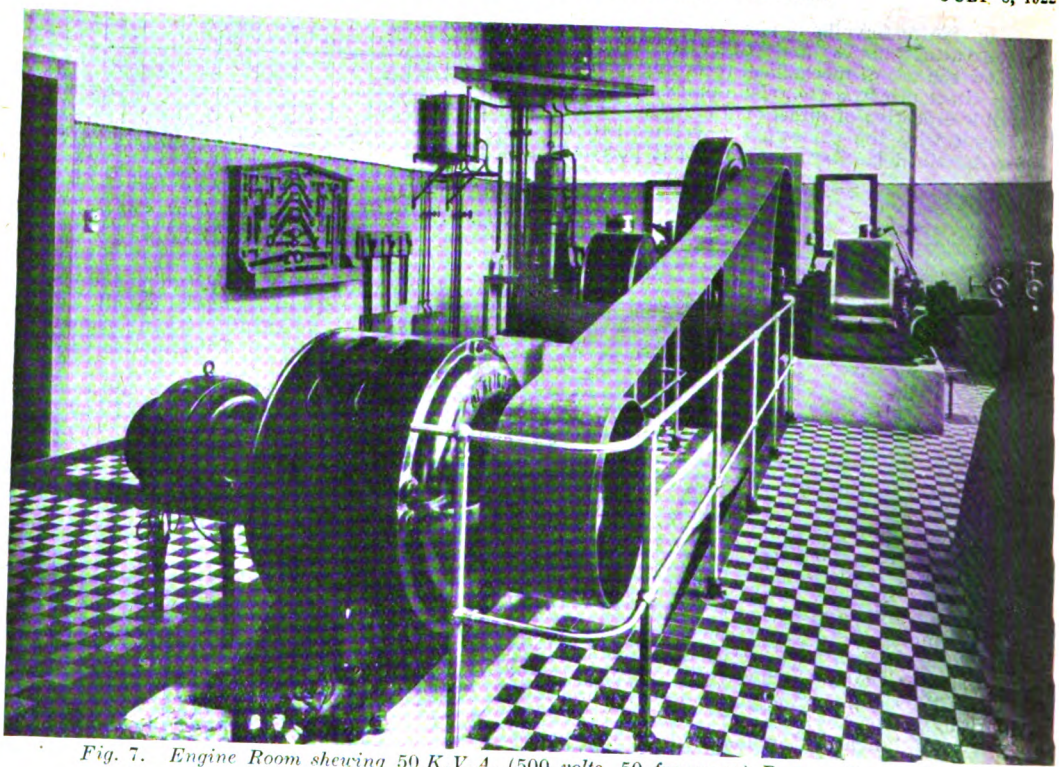

*Fig. 7. Engine Room shewing 50 K.V.A. (500 volts, 50 frequency) Reserve Power Plant.*

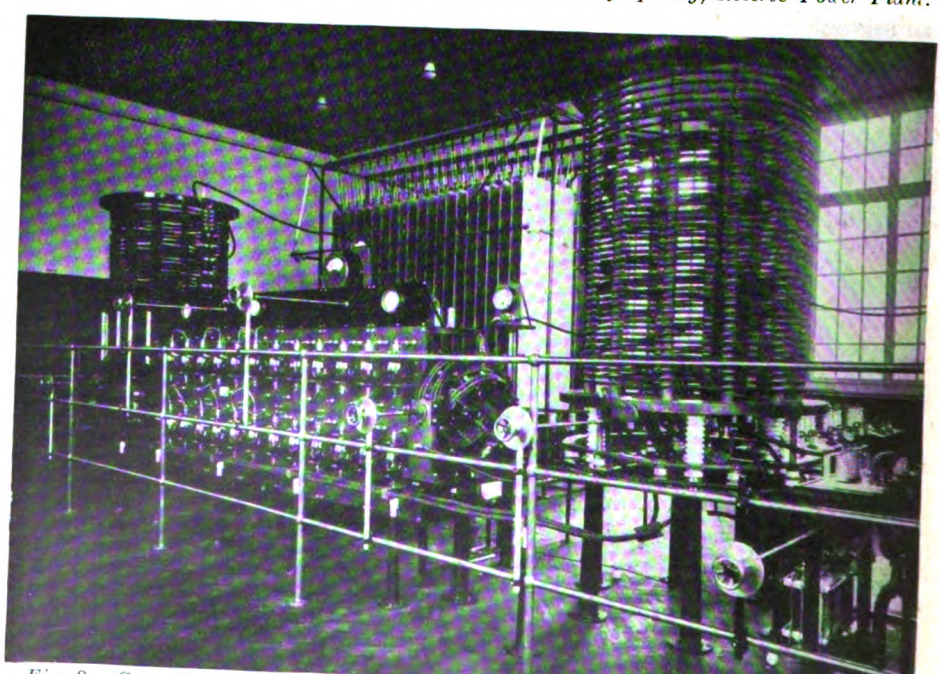

*Fig. 8. General View of the Transmitting Room, showing front of 25 kW Valve Panel, Main Air Condenser and Inductances.*

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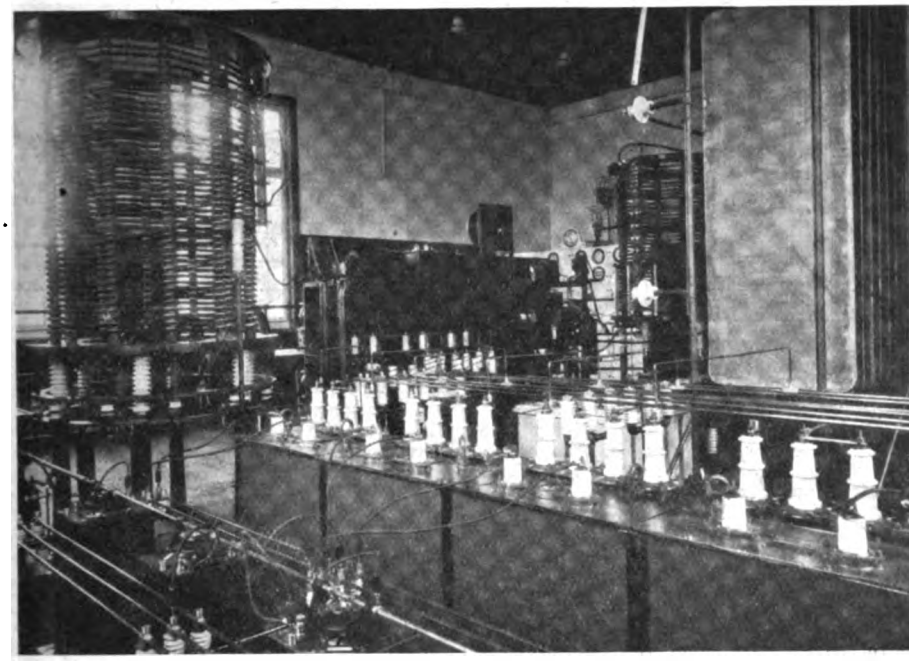

*Fig. 9. Another View in the Transmitting Room, showing High-tension Transformers, L.F. Chokes, and on the right the Main Air Condenser.*

principal towns in Switzerland and also Milan. Control of the transmitting station is arranged for both hand and high speed working. The high speed apparatus consists of three Gell automatic perforators for punching up the Wheatstone slip and two Creed Wheatstone transmitters, capable of working up to 150 w.p.m. The high speed received signals are passed on from the receiving station over ordinary land lines, and the signals are recorded on Marconi undulators, which are capable of speeds up to 120 w.p.m. For normal hand speed working the received signals operate a P.O. type sounder, but provision is also made for receiving by the ordinary method of aural reception by telephones, during bad receiving conditions or when receiving from stations, the transmission from which is not steady enough for automatic recording or which are not equipped for working at high speed. All instruments and circuits are in duplicate so that in case of breakdown or the necessity to make any adjustment, this can be done without interrupting the service. The necessary current required for the land line circuits is provided from the Berne Post Office central battery.

Figs. 8 and 9 are general views of the transmitting room.

## LIST OF EXPERIMENTAL STATIONS LICENSED IN THE UNITED KINGDOM.

Will holders of Experimental Transmitting Licences kindly notify the Editor of any changes that may be desired in the particulars of their stations published in the last issue. It is intended to reprint this list for handy reference, and amendments and additions must be received not later than the 15th July next.

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# Increasing the Traffic Carrying Capacity of a Radio Station.

THE output of a large wireless station from a commercial point of view is reckoned, not in electrical units, such as kilowatts, or kilowatt-hours, but in the number of words of traffic that it can effectively handle per hour, which quantity determines the earning capacity of the station. In ordinary practice this commercial output of a station is limited by many electrical considerations. It may be limited by the power expenditure in the transmitting plant, which may be sufficient to communicate over the desired range only during certain hours of the day, or it may be limited by the wavelength that it is necessary to employ in order to signal at all effectively over the desired range. In the latter case, if the wavelength is large, such as must necessarily be the case with high-power stations for communication over long distances, since a large aerial is required to absorb a large amount of energy, and a large aerial means a large capacity and consequently a long wavelength, the workable speed of transmission may be limited by the wavelength.

The use of a long wavelength means that the frequency of the oscillations in the aerial circuit must be comparatively low. Thus, for a wavelength of 20,000 metres, the oscillation frequency is only 15,000 per second, and if we want to signal at 120 words per minute, it means that the average "dot" signal lasts for not more than 1/300th of a second. Hence, during a single "dot" there cannot be more than 50 complete oscillations. In any oscillation circuit the current takes an appreciable time to build up to its final value after the application of the driving electromotive force, and in oscillation circuits employing resonance quite a considerable time—reckoned as number of cycles of E.M.F.—may elapse before the current approaches its maximum value. Hence, in the case of high-speed signalling at long wavelengths, there is not sufficient time for the currents to build up to their final steady values during the dot signals, and consequently either the effective signalling range of the station is reduced, or it must be operated at lower speeds of signalling.

In a recent communication to the French Academy of Sciences MM. Abraham and Planiol have outlined another method of reducing this difficulty. They have suggested that it is more profitable to operate the stations with "diplex" transmission, *i.e.*, with two simultaneous transmissions from the same transmitting aerials. Using the ordinary methods of working, this cannot be done without either duplication of a large part of the plant, with consequent increased capital cost for the station, or the sacrifice of a large proportion of the available power for radiation. Neither of these alternatives is attractive, and to avoid these difficulties it has been suggested that the emission of signalling energy from the transmitting aerials should be effected on any one of three alternative wavelengths, much as signalling is now often accomplished on two wavelengths—one for the "marking" signals and the other the "spacing" or "compensating" wave.

If now one of the transmitting keys is so arranged that when it is depressed it causes the radiation of a signal at a wavelength of $\lambda_1$, while the other likewise causes a signal to be sent out at a wavelength of $\lambda_2$, double transmission will be possible only so long as it is possible to ensure that only one of the keys is depressed at a time—a condition that is obviously not workable in practice. If now the circuits of the apparatus are so arranged that should both keys be depressed at the same time, the energy from the aerials is radiated, not at either of the above wavelengths, but at a new wavelength $\lambda_3$, the problem seems to be solved, as we have a characteristic radiation for each of the possible combinations of the positions of the two signalling keys.

To pick up such a transmission, each receiver must evidently be arranged so as to be equally responsive to two wavelengths simultaneously, *viz.*, $\lambda_1$ and $\lambda_3$, or $\lambda_2$ and $\lambda_3$, and not to be affected by the other transmission wavelength. This can be done comparatively easily by appropriate resonance and rejector circuits. Each receiver will then be enabled to hear its own transmission quite undisturbed by the other transmission which is going on at the same time from the same transmitting station.

Tests which have been carried out successfully between Nantes and Paris recently seem to show that the method is good in practice as well as on paper, and that in consequence it may soon find some practical application in commercial work. In addition to increasing the signalling capacity of the transmitting station, the method is also likely to add to the secrecy of the transmissions, since if the three wavelengths are not very close together, an ordinary type of radio receiver would be able to pick up one of the wavelengths only, and would consequently hear an unintelligible part only of one of the transmissions, or an equally unintelligible mixture of parts of the two. Should the three wavelengths be close enough together to affect an ordinary not specially selective receiver simultaneously, it would prove almost equally difficult to decipher the messages, since what would be heard would be a thorough mixture of the two sets of signals. With C.W. transmission this mixture would be heard by ordinary heterodyne methods as three different notes, one note conveying parts of the Morse signals of one of the transmissions, another note conveying parts of the other, and the third the remaining parts of the two mixed together—a combination which would appear to be not at all easy to unravel by ear.

As compared with the other methods, this one enables the full power of the transmitting apparatus to be employed all the time, so that not only is there no falling off in the signalling range of the station by its use, but the traffic-carrying capacity of the station would be approximately doubled.

P. R. C.

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# The Addition of One Stage of H.F. Amplification to the Reinartz Tuner.

By G. G. BLAKE, M.I.E.E., A.Inst.P.

IN *The Wireless World and Radio Review* for May 13th last, Mr. Percy W. Harris wrote an article on the Reinartz Tuner. As this tuner makes use of combined capacity and magnetic reactance, I gave a short description of my own Reinartz set at the conclusion of Mr. Reeves' paper at the last meeting of the London Wireless Society, a report of which appears in *The Wireless World and Radio Review* for June 24th.

It is one of the most selective tuners with which I have experimented, and almost entirely prevents jamming. I have listened in amongst the shipping on an openly tuned set, and heard several ships jamming one another, and have then changed over to the Reinartz Tuner and been able to separate them quite easily and hear the signals from any one of them without the least interference.

Against this advantage of great selectivity, and the fact that it reduces atmospheric interference to a minimum, this set reduces the signal strength to about two-thirds of its original value, so that although it is excellent for receiving loud signals or telephony from a powerful broadcasting station, it is of little use in picking up the weak telephony from amateur stations.

To overcome this defect I have added one stage of H.F. amplification which has very greatly increased the strength of weak signals and telephony.

The following are the connections employed:

Fig. 1 shows the ordinary single valve connections for a Reinartz Tuner. As this has already been fully described in the two issues of *The Wireless World and Radio Review* above mentioned, the diagram needs no further explanation. It will be remembered that the grid inductance G, aerial inductance A, and magnetic reactance R, are all wound on one former (and in the same direction).

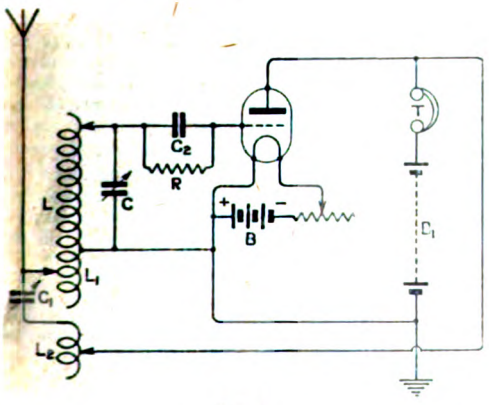


*Fig. 1.*

Fig. 2 shows the addition of one stage of H.F. amplification.

This set is intended for the reception of telephony from the broadcasting stations, and amateur short wave transmissions; its range is therefore anything from just below 180 metres up to 650 metres, and the number of tappings on the inductance is reduced

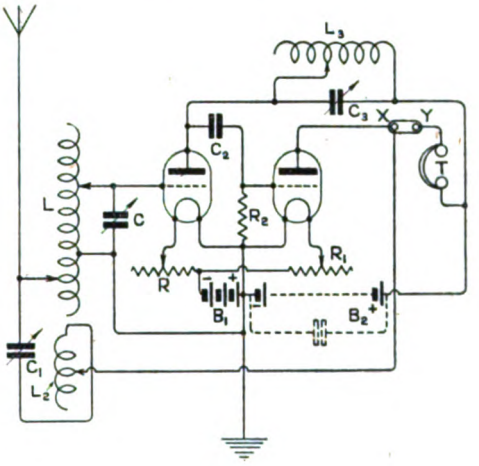


*Fig. 2.*

to a minimum. All are wound with No. 22 double cotton-covered wire on a 3 in. former. The grid inductance G has three tappings, one 20 turns from the point where the earth wire is attached to the inductance, one at the 35th turn, and the last one which is the end of the inductance is 50 turns from the earth.

The portion of the inductance below the earth terminal marked A on the diagram is shown with an adjustable connection to the aerial L. I find, however, in practice that a fixed 10 turns serves every purpose, as the aerial circuit functions aperiodically.

Now, with regard to the magnetic component of the reactance circuit. In order to conform strictly to the Reinartz plan, R should be wound on the same former as G and A, except that owing to the addition of the second valve, the direction of its winding must be reversed. I have tried it wound in this way with a fixed 40 turns and obtained quite good results; but I have found it decidedly better to wind it on a separate former a little smaller in diameter than that used for the inductance, and fix it permanently just inside the aerial portion of the inductance. The best position which will suit all wavelengths is arrived at after the set has been assembled by setting the variable reactance



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condenser C', which should have a capacity of at least 0·001 M.F. at the midway point on its scale, and then introducing the reactance coil until reaction just occurs. After this reactance is regulated entirely by altering the capacity of C'.

The other components of the set are, variable condenser C, grid condenser $C_2$, with grid leak K, filament battery B (6 volts), H.T. battery B1 (60 to 75 volts),* 2 separate filament resistances, F and $F_1$, and pair of high resistance telephones T.

High frequency amplification is obtained by means of auto-transformer coupling. It will be seen that the plate circuit of the first valve contains an inductance H, tuned by variable condenser $C_3$ (capacity 0·001).

The inductance H is wound with 36 turns of double cotton-covered copper wire 16 gauge on a 3 in. former, it is shown adjustable on the diagram, but in practice a fixed coil of 36 turns will cover the entire range of wavelengths for which this tuner is intended. This inductance H should be arranged at right angles to the grid inductance and as far as possible from it to avoid induction effects. Two terminals X and Y are shorted by a copper connector, and when it is desired to use the set in conjunction with a note magnifer, the connector is removed and X and Y are connected to the terminals of the input transformer of the note magnifier.

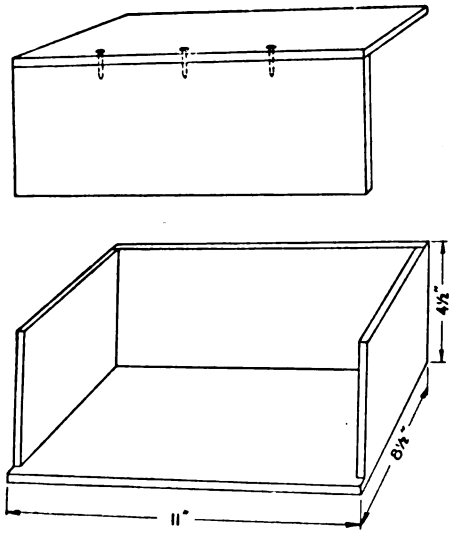


*Fig.* 3.

It will be noted that the high resistance telephones are left connected in order that they may act as an impedance. E in the diagram represents the earth terminal which is connected to the bottom of the grid inductance, between the positive of the L.T. and the negative of the H.T. batteries, also to the side of each of the valve filaments remote from the filament resistances.

The simplest method of tuning in a station is to buzz a wavemeter to approximately the required wavelength, and having set the reactance $C_1$ just over half in, tune C and $C_3$ simultaneously until the buzzer is most loudly heard in the telephones. It will be found that there is only one very sharp point on the scales of each condenser for each wavelength.

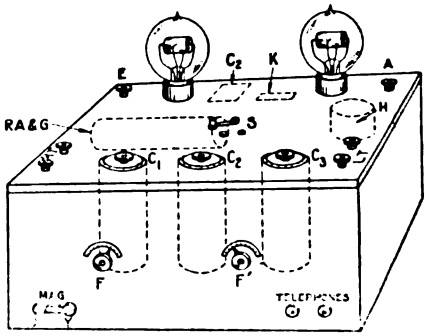


*Fig.* 4.

The signals are then brought up to the loudest possible value by varying the capacity of the reactance condenser C'.

Having tuned in the wavemeter its buzzer is stopped, and a very little further variation of C' and $C_2$ brings in the signals from the distant station.

Of course if no wavemeter is at hand its use may be dispensed with; but it then becomes a rather difficult matter, as the tuning is so exceedingly sharp.

The following constructional details may be of use to those readers who intend to make up a set.

Fig. 3 shows the dimensions of a suitable wooden case in which to mount the set. 11 in. by 8½ in. by 4½ in. (outside measurements).

The top and front are made of sheet ebonite and screwed together as indicated in Fig. 4, and the whole of the set being attached to these, comes away intact from the rest of the box, should repairs be necessary at any time.

Fig. 4. shows the whole set assembled. The dotted lines indicate how the various components are arranged below the ebonite top. R, A, and G represent the reactance, aerial and grid inductances. $C_2$ is the grid condenser, K the grid leak; all the other parts are lettered to correspond with the diagram.

The arm of switch S is connected to the grid of the first valve and condenser $C_2$, and is employed to connect up to one or other of the three grid inductance tappings. It should also be noted that H is placed at right angles to R, A, and G, and at as great a distance from it as possible.

* It is just as well to put a fairly large condenser across the H.T. Battery to serve the double purpose of smoothing out any slight irregularities in the output of the H.T. current and as a by-pass for high frequency oscillations. Quite good results, however, can be obtained without it.

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# The Reinartz Transmitter*

THE originator of the "Reinartz Tuner" for the reception of C.W. telegraph signals, has now produced a transmitter at his station that makes use of much the same principles as the receiver, and is quite as novel.

His set is a panel using four U.V.202 "Radiotrons," with 700 volts of rectified but unfiltered A.C. on the anodes, antenna currents up to 3½ amperes being obtained. Photographs with this article show front and rear views of the panel, about which there is nothing particularly unusual except the two spider-web coils, one at either end of the main inductance.

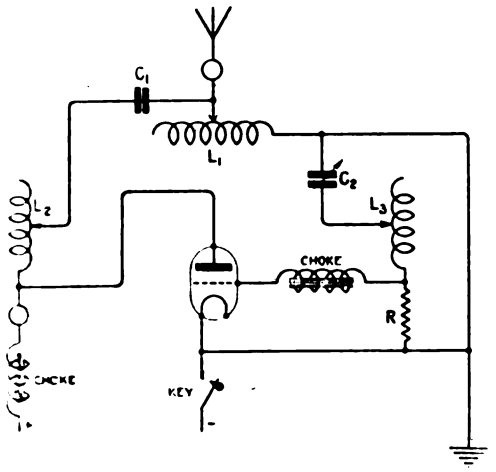
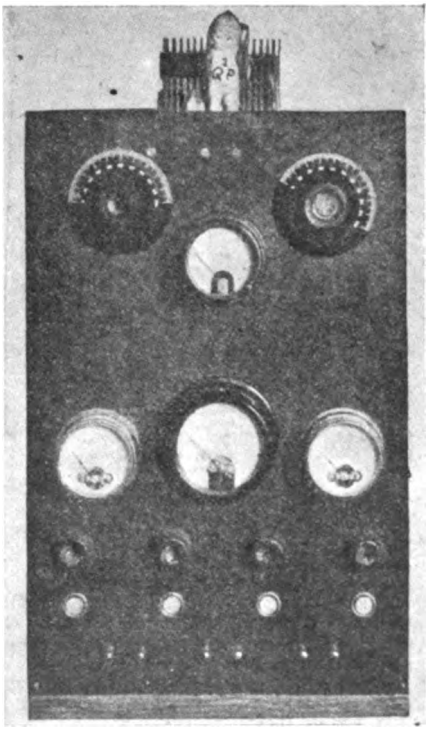



*Fig.* 1.

The wiring diagram is shown in Fig. 1. $L_1$, the main tuning inductance, is a helix of 8 ins. by ½ in. edgewise-wound copper strip. $L_2$ and $L_3$ are the spider-webs, respectively in the plate and grid circuits, both wound of No. 24 D.C.C. wire on 2½ in. centres. $L_3$ has a total of 75 turns, tapped every 15 turns, while $L_2$ has ten taps of 5 turns each. $C_1$ is a fixed mica condenser, high-voltage type, capacity 0·002 mfd. or thereabouts, while $C_2$, the grid condenser, is an air variable of 7 plates widely spaced to stand the voltage, built up from a 13 plate of ordinary construction, with movable plates to ground. $C_2$ is operated at very low values of capacity but must be variable. The grid leak R has a resistance of 10,000 ohms and the same value is used for any number of tubes from one to four, correction apparently being got by adjusting the value of C.

It will be remembered that in the Reinartz receiving tuner the aerial circuit is untuned and shocks the tuned secondary circuit into oscillation at the latter's period, reducing tuning to one control. (Because of the loose coupling afforded by the fact that the aerial circuit consists of but a turn or two of the coil, the tuning is much sharper than in the usual single-circuit tuner.) Rather naturally, the transmitter observes the reverse of the receiver performance—over a considerable band of wavelengths the grid and plate circuits operate aperiodically and the radiated wavelength is determined solely by the position of the antenna clip on $L_1$. Thus a wavelength of 174 metres is produced when but one turn of aerial inductance is used, climbing to 212 when 6 turns are used, and the antenna current remains constant regardless of the shortness of wave.

It is a little puzzling to trace out the theory of the thing from Fig. 1, so let us turn to "A" in Fig. 2, which shows the same thing. Immediately we recognise the circuit of the Reinartz receiving tuner, except that the location of the grid condenser has been changed. Compare this with "B," which is the popular circuit giving such excellent results in many amateur stations. $L_1$ and $L_3$ are the same and the only difference is that where "B" uses the unused turns of the main helix for the inductance $L_2$, circuit "A" uses a separate



*The Reinartz Transmitter (Front View).*

* Extracted from "*QST*," June 1922.

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winding $L_2$. It is quite permissible to have this inductance separate; it is a reactance for the adjustment of the output impedance of the tube and does not even have to be coupled to $L_1$. In fact in the Reinartz set neither $L_2$ nor $L_3$ need to be coupled to the main helix and are placed at the ends of the winding merely because it was convenient structurally to arrange them there. When so coupled, however, the polarity is important of course—in one direction only do they work well. Fig. 1 shows no coupling between them.

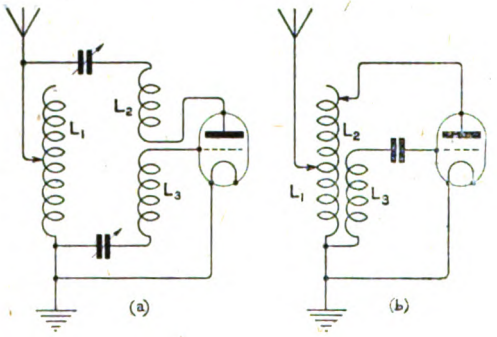
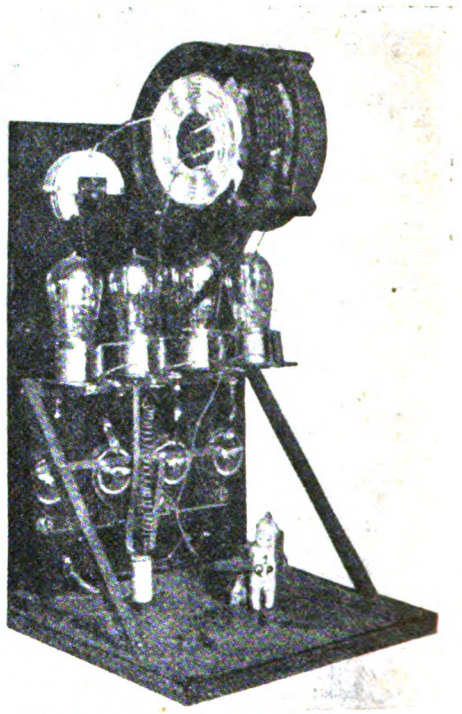



*Fig. 2.*

The set is easy to adjust. The antenna clip determines the wavelength. Grid circuit $C_2$ $L_3$ must be set approximately right by selecting the proper tap on $L_3$ and getting final adjustment by securing the best value of $C_2$. As in any such circuit, preliminary adjustments are made using all of the inductance of $L_2$ gradually cutting it down as the efficiency is improved. If the anode voltage is variable it too should be reduced while first adjustments are being made. As the adjustments proceed increased efficiency will be apparent mainly by a reduction of the input to the tube—a reduction that drops it below the normal safe rating—whereupon the voltage is increased to bring the input up to normal, the output increasing proportionately, with about the same efficiency as before.



*The Reinartz Transmitter (back view).*

# A Method of Increasing the Life of a Valve.

By W. M. BUCHANAN, JR.

ECONOMICS, the subject perplexing the political world of the present day, can be applied to the wireless amateur with reference to his valves, not that it will save him from buying one, but rather that the valve, when once purchased, may live a little longer than is usual.

In this article I will attempt to explain a weakness which has come under my notice and propose a method of reducing this disadvantage to a minimum. The weakest part of the valve (needless to say) is the filament, and to this part I will confine my arguments.

In any text-book on the valve it will be stated that if a heated filament comes under the influence of a *positively* charged body such as the plate of a valve, electrons will be emitted from the filament to this body, as in Fig. 1a, but in the case of Fig. 1b where the plate is *negatively* charged, no emission will take place. It is therefore obvious (and will be found if the above experiment be carried out using a milliammeter in the plate circuit for determination of emission current), that the electrons emitted from the filament are negatively charged. Since the filament generates negative electrons (or rather that the plate attracts only these negative electrons), it is evident that the greatest number of electrons will be emitted from the negative end. This means that the negative end having the largest strain will ultimately break down leaving the remaining part of the filament in good condition.

The method I had in view was not exactly to minimise this effect, but rather to balance it by altering the polarity of the filament at will, by means of a change-over switch as shown in Fig. 2, and working the valve off both sides alternatively for equal periods of time.

The above method will naturally increase the life of a valve, and I leave it to the reader as to whether he thinks it more economical to use perhaps two valves in place of one with the addition of a double pole change-over switch.

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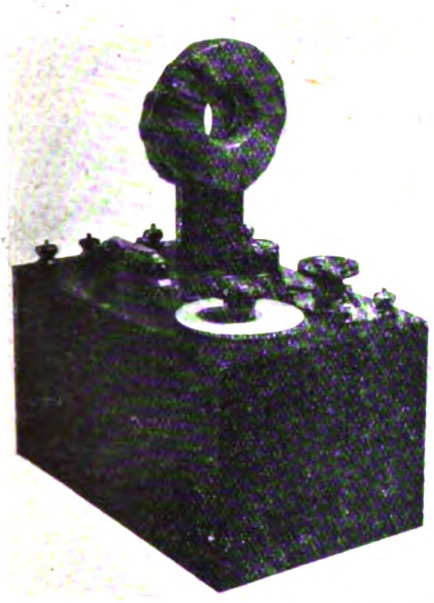
# Practical Notes on Building a Long-Wave Heterodyne

By PERCY W. HARRIS.

THE many advantages to be obtained by the use of a separate heterodyne can only be appreciated by those who have worked with these instruments. In particular, of course, the radiation from receiving aerials—inevitable with simple autodyne circuits—is cut down to a negligible point, and tuning and strength of signals are both improved. In conjunction with reaction* a separate



*The finished instrument with 2 coils in place.*

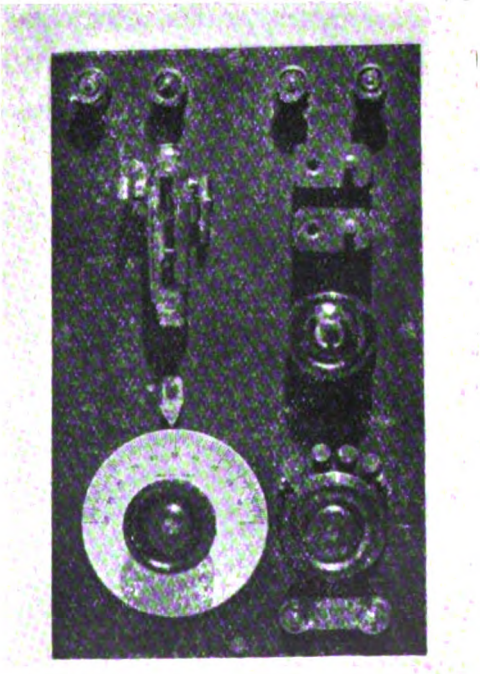
heterodyne will enable the strength of signals from long-wave stations to be increased to a remarkable degree.

The excellent articles by Mr. Philip R. Coursey in *The Wireless World and Radio Review*† contained particulars of, and designs for, some very useful heterodynes. It occurred to the writer that the less experienced readers might like particulars and constructional details of one such instrument, constructed strictly on the lines laid down in the articles, and used with great success for long-wave reception.

The design chosen was that described in the issues of May 6th and 13th, using two coils, a variable condenser and three additional fixed condensers, with a V24 valve. The finished instrument is illustrated in the first photograph, which shows the two coils in place.

The box was made from ⅜ walnut, purchased from a dealer in fretwork materials. This wood looks well, and takes a good finish. The top is of ⅜ ebonite, the original skin being removed with fine emery. A view of the top is given in the second illustration. The terminals are the well-known Mark Three type, a ring of black and red paint being made on the negative and positive terminals respectively. The on-and-off switch was purchased from a dealer in motor-car fittings, and the switch below it is taken from an old Mark Three tuner, on which it was used for secondary tappings.

The plugs are "Burndept," with the curved portions sawn off. (This is not a very simple task, and needs care.) The condenser is of the well-known army pattern, value 0·0015 mfd., with a white 100 degree dial and the standard ebonite knob



*A top view of the long-wave heterodyne.*

* ***The Wireless World***, February 4th, p. 696.

† ***The Wireless World and Radio Review*** of May 6th, ***et seq.***

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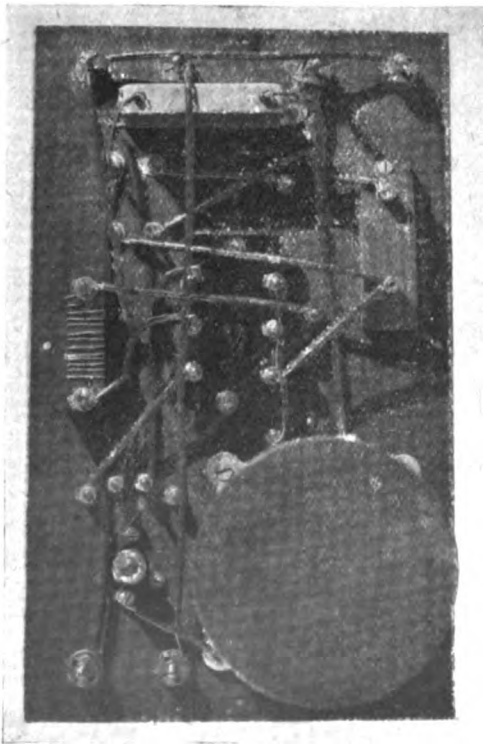
substituted for the better-known graduated dial usually fitted. The white dial is the more pleasant to use, and the 100 degree scale is, in the writer's opinion, much better than the conventional 180 degrees dial. On this latter each division stands for *two* degrees of the scale, so that there are only 90 markings. Experience shows that in quick work the first division after a marked figure is often taken as *one* more than the marking (*e.g.*, one degree after twenty is often counted as twenty-one, whereas it is really twenty-two). With the hundred-degree scale with a hundred markings this cannot give rise to any misunderstanding, and, in addition, one has the advantage of a little finer graduation.

Valve clips were purchased ready made, and fitted with 6 BA screws and nuts. The condenser pointer was cut from strip brass and similarly fixed.

The third photograph shows the underside of the panel with the wiring, all of which is covered with "Sistoflex" insulation. The fixed condenser at the top is a Dubilier. The grid leak is the pencil-mark type (on the right), and the filament resistance was made from one ohm of eureka wire wound on a strip of ebonite held away from the panel by two small pieces of the same material beneath the securing screws (on the left).



*The underside of the panel showing the wiring.*

The three fixed mica condensers were first of all secured side by side by their lugs to a strip of ebonite, about 1½ by 2½ ins., the screws securing them passing through the ebonite and terminating in locknuts. The strip was then secured to the underside of the panel, the condensers upwards and the projecting screws downwards. This fitting is seen in the centre of the underside of the panel.

Examination of the illustration will show the six terminals of these condensers in two rows. The three on the right are joined to a common wire which is taken to one terminal of the variable condenser. The three on the left are taken to their respective studs on the four-stud switch, the arm of which is connected (by a lead which passes round the underside of the case) to the other variable condenser terminal.

The measurements given by Mr. Coursey for the placing of the plug sockets are correct for Burndept coils, but are rather too close together for Igranic coils, which are wider than the Burndept. Users of the Igranic pattern should therefore allow another ¼ in. separation.

The writer takes this opportunity of confirming Mr. Clinker's observations on the use of reaction with a separate heterodyne. His article understates, if anything, the strength of signal obtainable.

IN PROUD AND GRATEFUL MEMORY
OF OUR COLLEAGUES
WHO LAID DOWN THEIR LIVES DURING
THE GREAT WAR 1914-1918
THEY DYING SO LIVE

*Memorial Tablet recently unveiled at Marconi House to the Memory of those who gave their lives in the War.*

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# Oscillations in Three Coupled Electric Circuits.*

By S. P. OWEN, M. Sc., A. Inst. P.

A GENERAL solution containing arbitrary constants was given by Jackson (*Philosophical Magazine* 42, Sixth Series, p. 35). Apart from his work and that of Bellini, the attention given to the problem has been very scanty.

Owing to its increasing importance in Wireless Telegraphy, the present paper is written with the purpose of obtaining a general solution in terms of the general initial conditions. A solution in this form does away with the necessity of solving for the values of the arbitrary constants, a process which usually involves a large amount of analysis.

(a) Writing the equations of motion in the form

$$\left.\begin{aligned} e_1 + R_1C_1\frac{de_1}{dt} + L_1C_1\frac{d^2e_1}{dt^2} + M_{12}C_1\frac{d^2e_2}{dt^2} + M_{13}C_1\frac{d^2e_3}{dt^2} &= 0 \\ e_2 + R_2C_2\frac{de_2}{dt} + L_2C_2\frac{d^2e_2}{dt^2} + M_{23}C_2\frac{d^2e_3}{dt^2} + M_{21}C_2\frac{d^2e_1}{dt^2} &= 0 \\ e_3 + R_3C_3\frac{de_3}{dt} + L_3C_3\frac{d^2e_3}{dt^2} + M_{31}C_3\frac{d^2e_1}{dt^2} + M_{32}C_3\frac{d^2e_2}{dt^2} &= 0 \end{aligned}\right\} \quad \ldots\ldots (1)$$

where $e$, $R$, $C$, $L$ and $M$ represent the charge on the condenser at time $t$, resistance, capacity, self-inductance and mutual inductance respectively, the circuits being distinguished by the suffixes 1, 2, 3, the solutions may be written in the form†

$$e_1 = \frac{1}{2\pi j}\int \xi\, \epsilon^{\alpha' t}d\alpha \qquad e_2 = \frac{1}{2\pi j}\int \eta\, \epsilon^{\alpha' t}d\alpha \qquad e_3 = \frac{1}{2\pi j}\int \zeta\, \epsilon^{\alpha t}d\alpha \qquad (j = \sqrt{-1})$$

where $\xi$, $\eta$, $\zeta$ are functions of $\alpha$ to be determined, and the integrals taken over a table contour in the $\alpha$ plane, so as to contain all the poles of the functions $\xi$, $\eta$, $\zeta$.

Substituting these integrals in the equations (1).

$$\left.\begin{aligned} \xi(1 + R_1C_1\alpha + L_1C_1\alpha^2) + \eta M_{12}C_1\alpha^2 + \zeta M_{13}C_1\alpha^2 &= p \\ \xi M_{21}C_2\alpha^2 + \eta(1 + R_2C_2\alpha + L_2C_2\alpha) + \zeta C_2M_{23}\alpha^2 &= q \\ \xi M_{31}C_3\alpha^2 + \eta M_{32}C_3\alpha^2 + \zeta(1 + R_3C_3\alpha + L_3C_3\alpha) &= r \end{aligned}\right\} \quad \ldots\ldots (2)$$

where $p$, $q$ and $r$ are determined by putting

$$\xi = \frac{e_{10}}{\alpha} - \frac{i_{10}}{\alpha^2} \qquad \eta = \frac{e_{20}}{\alpha} - \frac{i_{20}}{\alpha^2} \qquad \zeta = \frac{e_{30}}{\alpha} - \frac{i_{30}}{\alpha^2}$$

in the left-hand side of equations (2), and rejecting all negative powers of $\alpha$ (Bromwich, *loc. cit.* p. 404).

The added suffix 0 denotes the initial values of the charges and currents respectively.

Clearly we have

$$p = (R_1C_1 + L_1C_1\alpha)e_{10} - L_1C_1i_{10} - M_{12}C_1i_{20} - M_{13}C_1i_{30}$$

and similar values for $q$ and $r$.

Writing the equations (2) in the form

$$\begin{aligned} a_1\xi + b_1\eta + c_1\zeta - p &= 0 \\ a_2\xi + b_2\eta + c_2\zeta - q &= 0 \\ a_3\xi + b_3\eta + c_3\zeta - r &= 0 \end{aligned}$$

we have

$$\frac{\xi}{\begin{vmatrix} b_1 & c_1 & -p \\ b_2 & c_2 & -q \\ b_3 & c_3 & -r \end{vmatrix}} = \frac{-\eta}{\begin{vmatrix} a_1 & c_1 & -p \\ a_2 & c_2 & -q \\ a_3 & c_3 & -r \end{vmatrix}} = \frac{\zeta}{\begin{vmatrix} a_1 & b_1 & -p \\ a_2 & b_2 & -q \\ a_3 & b_3 & -r \end{vmatrix}} = \frac{-1}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}$$

$$\text{or } \frac{\xi}{f_1(\alpha)} = \frac{-\eta}{f_2(\alpha)} = \frac{\zeta}{f_3(\alpha)} = \frac{-1}{F(\alpha)}$$

* Received

† Bromwich, *Proceedings of the London Mathematical Society*, 15, p. 401, 1916.

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Then

$$e_1 = -\frac{1}{2\pi j}\int \frac{f_1(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha \qquad e_2 = \frac{1}{2\pi j}\int \frac{f_2(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha \qquad e_3 = -\frac{1}{2\pi j}\int \frac{f_3(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha.$$

Choosing a suitable contour enclosing all the zeros of $F(\alpha) = 0$ we have by Cauchy's Theorem—

$$e_1 = -\Sigma_1 \frac{f_1(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t} \qquad e_2 = \Sigma \frac{f_2(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t} \qquad e_3 = -\Sigma_1 \frac{f_3(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t}$$

where $\alpha_n$ is the $n^{th}$ root of $F(\alpha) = 0$, the summation taking place over all the roots and $F'(\alpha) = \frac{dF(\alpha)}{d\alpha}$.

The equation $F(\alpha) = 0$, *i.e.*,

$$\begin{vmatrix} 1 + R_1C_1\alpha + L_1C_1\alpha^2, & M_{12}C_1\alpha^2, & M_{13}C_1\alpha^2 \\ M_{21}C_2\alpha^2, & 1 + R_2C_2\alpha + L_2C_2\alpha^2, & M_{23}C_2\alpha^2 \\ M_{31}C_3\alpha^2, & M_{32}C_3\alpha^2, & 1 + R_3C_3\alpha + L_3C_3\alpha^2 \end{vmatrix} = 0$$

is clearly of the sixth degree and the numerical values of the coefficients are such, in practice, that it has roots of the form $-p \pm j\omega_1$, $-q \pm j\omega_2$, $-r \pm j\omega_3$. From this it follows that the charge and current in each circuit consist of three damped oscillations, the periods of the oscillations being the same in each circuit, differing only in amplitude.

A general solution of $F(\alpha) = 0$ is difficult to obtain. If the numerical values of the coefficients are known, graphical methods may be employed.

(b) The above solution may be verified by taking the simple case where the circuits are completely separated and the initial conditions

$$e_{10} = C_1V_0. \qquad e_{20} = e_{30} = i_{10} = i_{20} = i_{30} = 0.$$

Also it will be assumed that the resistances $R_1$ $R_2$ $R_3$ are negligible.

Since $M_{12} = M_{13} = M_{23} = 0$

then $p = C_1V_0L_1C_1\alpha$ where $V_0$ is the potential initially

$$q = 0$$
$$r = 0$$
$$f_1(\alpha) = -C_1^2V_0L_1\alpha(1 + L_2C_2\alpha^2)(1 + L_3C_3\alpha^2)$$
$$f_2(\alpha) = f_3(\alpha) = 0$$
$$F(\alpha) = (1 + L_1C_1\alpha^2)(1 + L_2C_2\alpha^2)(1 + L_3C_3\alpha^2)$$
$$\therefore e_1 = \frac{1}{2\pi j}\int \frac{C_1^2V_0L_1\alpha}{1 + L_1C_1\alpha^2}\epsilon^{\alpha t}d\alpha.$$
$$e_2 = e_3 = 0.$$

Roots of $1 + L_1C_1\alpha^2 = 0$ are $\alpha = \pm \frac{j}{\sqrt{LC}}$.

$$F'(\alpha) = 2\alpha L_1C_1$$
$$\therefore e_1 = \tfrac{1}{2}C_1V_0\int \epsilon^{j(t/\sqrt{L_1C_1})} + \epsilon^{-j(t/\sqrt{L_1C_1})}$$
$$= C_1V_0\cos\left(\frac{t}{\sqrt{L_1C_1}}\right)$$

which is the result obtained by solving the equation $L_1C_1\frac{d^2e}{dt^2} + e = 0$ with the initial condition $e_0 = C_1V_0$.

ROYAL GRAMMAR SCHOOL,
NEWCASTLE-ON-TYNE.

*April 8th*, 1922.

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# How to Get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS
(Author of "The Maintenance of Wireless Telegraph Apparatus.")

### IV.—THE SELECTION AND CARE OF ACCUMULATORS.—(*Continued.*)

WHEN cells are purchased new, they are dry and need acid to be added to them. The composition and purity of this acid solution is of the utmost importance, and the beginner is well advised to purchase the ready made-up solution from a reputable firm. The more experienced man can prepare it by adding pure sulphuric acid to distilled water, following the makers' instructions as to specific gravity of the resultant liquid. Generally, and unless the user is experienced, the cell should be taken new to a firm who will undertake the first charge, as this is always lengthy. It will then be returned fully charged and filled with acid at the correct specific gravity for the particular cell.

Every accumulator user should provide himself with two instruments—a voltmeter and a hydrometer. The first should read to eight or ten volts at the most (otherwise the scale will be too compressed for accurate reading) and should be of good make. Any cheap voltmeter will not do, as an error of half a volt either way may lead to serious consequences in using accumulators. Battery-testing voltmeters are listed by every dealer of repute.

Improperly used, a voltmeter may give very misleading indications of the condition of an accumulator. When fully charged, each cell should give very slightly over two volts. The voltage soon drops to two and remains at this figure until nearly all the useful charge is dissipated. Towards the end of the discharge period, the voltage begins to fall rapidly, and in no circumstances should the cell be discharged below 1·8 volts, *the reading being taken whilst the battery is passing current through the circuit for which it is normally used.* It is necessary to emphasise this point, as a cell which has been discharged below the safe limit can, after standing disconnected for a short period, give a reading of about two volts provided it is not in circuit. It will be clear from the explanation given above that the fact that a cell shows two volts is no indication whatever that it is fully charged, even if the reading is taken during discharge. The two-volt reading is simply an indication that the cell has not yet been discharged to the safe limit.

The second instrument mentioned as a necessary part of the accumulator user's equipment is the hydrometer. This is a device for showing the specific gravity of the acid, which itself indicates far better than anything else the condition of the cell. When fully charged (and of course provided the correct acid has been used in the first place) the specific gravity (S.G. for short) should be about 1·2 in each cell, and as the charge is withdrawn the S.G. steadily falls until at the safe limit of discharge it is about 1·185. Precise figures cannot be given here, as different makes of cell have different figures. Practically every maker marks the cells with the correct S.G. figures for charge and discharge.

If, then, we take a reading of the S.G. of the acid in a cell, we shall be able to learn whether the cell is fully charged, discharged to the safe limit, or of what amount of charge is still available.

When cells are nearing the completion of their charge, a fine spray is emitted from the surface of the acid, due to the bursting of innumerable bubbles of gas. The gas is inflammable and should therefore be kept away from an open flame, and the acid spray is very corrosive. After a time the level of the acid may sink from evaporation of the water, and should be brought up to the original point (just above the plates) by the addition of distilled water. The correct S.G. will in this way be maintained, as the evaporation of the water concentrates the acid. If further *acid* were added, the S.G. would be too high.

On no account should tap water be used for "topping" cells, as the mineral salts contained in the water are highly injurious to the plates. Distilled water only is permissible.

All terminals should be kept covered with a thin coating of non-corrosive vaseline, to prevent bad effects from the acid spray and from "creeping." It should be unnecessary to point out that furniture and carpets are not improved by accumulator acid, and if cells are used in living-rooms, adequate precautions should be taken.

There are several types of hydrometer on the market for accumulator testing. Perhaps the most generally useful for the amateur is the type consisting of a glass tube fitted with a rubber bulb with which the acid can be drawn up into the tube. Inside the tube are three glass beads of different colours. When the S.G. is highest all three beads float, and when it is lowest none will rise. At an intermediate value two out of the three will float. In this way a good general idea of the state of the acid is obtainable.

For general valve work a six-volt battery should be purchased, as although a four-volt battery will suit many valves, this voltage leaves little to spare for adjustment through a rheostat. A good size for a three-valve set is a 40 ampere hour (actual). For a two or one-valve set the battery can be proportionately smaller, although a larger battery will of course last longer without charging.

EDISON ACCUMULATORS.

A type of accumulator which has been used for wireless purposes abroad a great deal, and to a small extent in this country, is the Edison, which differs radically from the type of cell we have been describing. In the Edison the positive plates consist of a series of perforated nickel-steel tubes, containing many layers of tightly rammed nickel oxide and pure nickel in flakes. The negative elements are also of steel, with a number of pockets filled with iron oxide. Steel containers, ribbed for strength, are used throughout. The electrolyte is a 21 per cent. solution of potassium hydrate (caustic potash solution) with a certain amount of lithium hydrate added. The S.G. of this solution is 1·21, and this figure does not vary throughout charge and discharge. Evaporation is made up by adding distilled water only. The voltage per cell is low, averaging on discharge 1·2. The battery is usually discharged down to 1 volt per cell. The whole battery can be completely discharged and left in this condition for months without injury. Even short-circuiting does no harm.

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# Experimental Station Design

(*Continued from page* 393, *June 24th*, 1922.)

***These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.***

***Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.***

***The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.***

## VII. A SIMPLE VALVE PANEL.

THE complete panel is shown in Figs. 1 and 2. Fig. 1 represents the top and Fig. 2 is a view of the under side when the instrument is turned over. Both drawings are exact full size.

One edge of the ¼ in. polished ebonite sheet must first be filed straight and true and at right-angles to the faces. As the piece of ebonite is 6 ins. wide it may not be possible to insert it far into the vice, and it will therefore be necessary to prevent vibration while filing. This can be done by clamping a piece of planed inch board on either side of the ebonite, leaving only ¼ in. projecting. One of the end edges must next be squared off in the same way as was described for the construction of the small wavemeter condenser, though it will be a little more difficult in this case owing to the increased dimensions. Measuring back along the trued edge from this end, mark off 5 ins. for the length of the panel and scratch a line across the face exactly at right angles to the edge. Saw off the spare portion and file true to the line. The width of the panel is 4¼ ins. and points are marked off along either end at this distance from the trued edge, and a scratch line ruled between them. If the two ends are at true right angles to the edge this line should prove to be also at right angles to either of the ends. In order to give good finish to the edges they may be rubbed down by firmly holding the panel and sliding the edges in turn along a piece of emery nailed to the bench. Care must be taken to keep the panel standing exactly vertical during the process, and giving even pressure along the whole edge. Too much stress cannot be laid upon the necessity for care and accuracy. Good workmanship is evidenced by attention to detail, and as the processes described are quite simple and require no special skill, but merely a little patience, the reader is entreated to do his best to obtain a good finish to his instrument.

The next step is to make the two condenser covers, marked G and P in Fig. 1. These are exactly square, and measure 1¼ ins. each way. They are made from the spare end piece and by the methods already described. Holes are put through their four corners to give clearance for No. 6 BA screws, and a No. 28 or 7/64 in. drill will make a suitable hole. No countersinking is necessary as round-headed screws are used.

Putting these pieces aside, the next consideration is the marking out of the top for the various holes. This is done on the under side, that is the view shown in Fig. 2. Where two or more screws are in line, a fine scratch line must be made with a divider point, scriber, or a sharpened up tag of a file, and the spacing between the holes marked up along the line. Endeavour, as far as possible, to make all measurements from two edges only, which are at right angles to one another. Make all measurements with the utmost precision, as the eye can distinguish the minutest discrepancy, or lack of balance due to erroneous setting out. The position for the holes for the valve socket is particularly important and a slight inaccuracy will result in a bad fitting for the valve. All points where holes are to be put through must be centre-punched to prevent the drill from wandering over the smooth surface. Before drilling it is worth while to one unaccustomed to this work to go over all the points with a rule and confirm that they are correctly located. The point of intersection of the diagonals of the valve socket is ⅝ in. from the top edge, and the centre for the resistance lever bearing ⅞ in. lower. The first holes to be made are those near the edges which are to carry the twelve 4 BA screws for terminals. These are made with a 5/32 in. drill and in putting them through, a piece of hard wood or scrap ebonite should be clamped to the back face to prevent cracking away as the drill passes through. Two 5/32 in. holes are made to pass the screws which hold down the former on which the filament resistance is wound. Holes must also be made to pass the ends of the resistance wire, and likewise the leads to the condensers. If the four valve stems have 4 BA threads, holes can be put through to give clearance for them without changing the drill. It is more usual, however, for them to be 6 BA, in which case the No. 28 drill should be employed. Using this drill the eight holes can be made to pass the 6 BA screws which hold down the condenser covers. In order that these holes may exactly coincide with those already made in the cover pieces, it will be found convenient to drill one only of each of the four holes. By using these holes to keep the covers in position the remaining holes are made by passing the drill through the other holes already in them. Before putting the cover pieces aside again they should be marked to show the exact position they occupied when the holes were made so as to avoid any risk of them

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being interchanged, turned over, or turned round. Four holes will now complete the drilling, which are those passing through the four wooden battens. These battens are to space the panel above the surface of the operating table, and are ¼ in. thick. The holes made in them are to give clearance to the 1½ in. by No. 6 brass wood screws which hold the panel in position.

These battens should preferably be made of hard wood, and may be planed or filed to size.

traction which would slacken the winding. The wire must be entirely free from kinks, and having determined approximately the length required, one end is held in the vice, and keeping it taut, the former is revolved and the wire wound on.

The resistance arm is made from a piece of hard brass of thickness of about 20 S.W.G., and is shaped as shown in Fig. 1. One edge of the brass is turned up to a height of ⅛ in. to give stiffness. The end is also turned up, giving a projection of ¼ in. to act

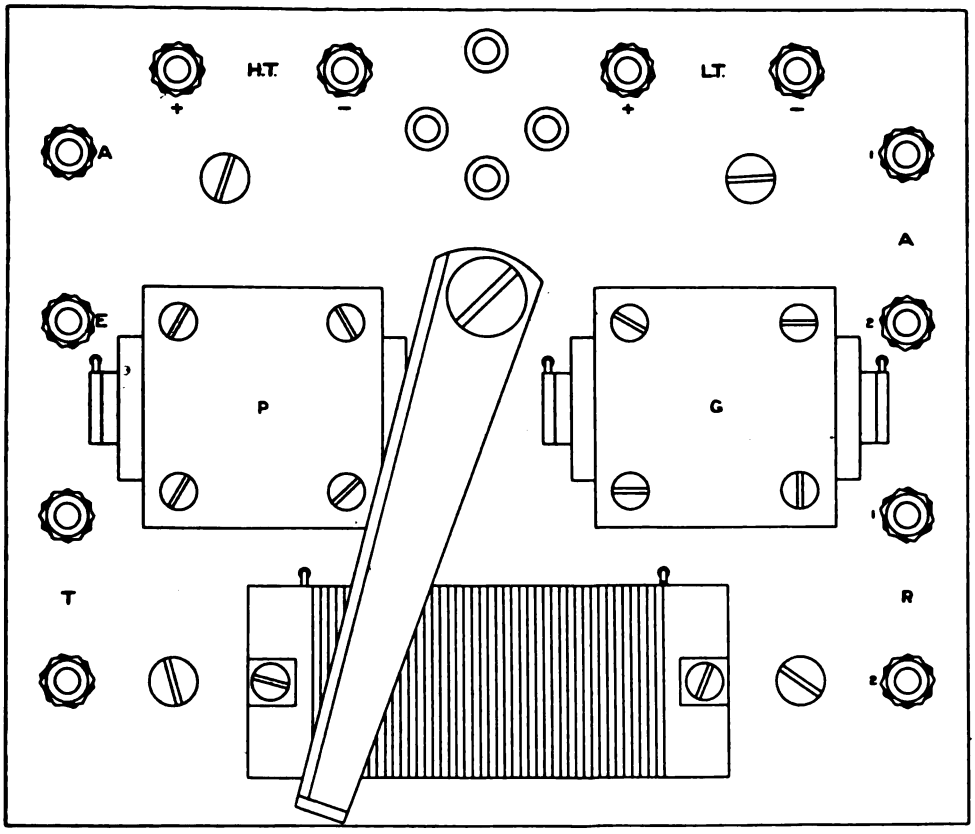


*Fig. 1. The valve panel (top) drawn to full size.*

The wooden former, Fig. 3, on which the resistance wire is to be wound, can also be filed to size, and it is important that the top edge shall be quite straight and parallel to the under edge in order that the rubbing arm may give even pressure throughout the length. The ridge along the top is filed away at the ends to give flat faces for the screws, holes for which are made with the 5·32 in. drill. Two other holes are made near the ends for the purpose of passing through and holding the resistance wire. In winding the former it is necessary to keep a strong tension on the wire and make it bind into the surface of the wood. It is as well to dry the wood before commencing to wind in order to prevent any subsequent con-

as a handle. If there is any tendency for the brass to break while making these bends it should be held in a flame until it is a dull red heat, and then dipped in cold water. This will soften it and with care is unnecessary, but should it have been done the flat portion of the arm must be carefully hammered in order to renew the stiffness. The bearing for the arm is made from a large O BA terminal with a screw-on top, or with a screw top as shown in the figure. If a screw-on top is used it will need to be hammered over when in position or treated with a little solder to prevent it coming unscrewed. Before attempting to assemble, all of the ebonite faces must be rubbed down with very fine emery paper, which, if used attached to a



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small block of wood and revolved in small circles, a good matt finish will be obtained entirely free from scratches.

In placing the resistance in position and obtaining the correct pressure by the arm on the wire, small ebonite or wood spacing pieces are inserted as shown in Fig. 3, their exact thickness depending upon the height of the terminal. The building up of the condensers is as described in the previous article.

Fifteen pieces of mica interleaved with copper foils passing out alternately to opposite ends will be required for the condenser marked "P." For that marked "G" four pieces of mica will be required and one foil will project out at one end and two, being one on either side of it with mica interleaved, out of the other. The two other micas are on the outer faces. This latter condenser is bridged with a high resistance leak.

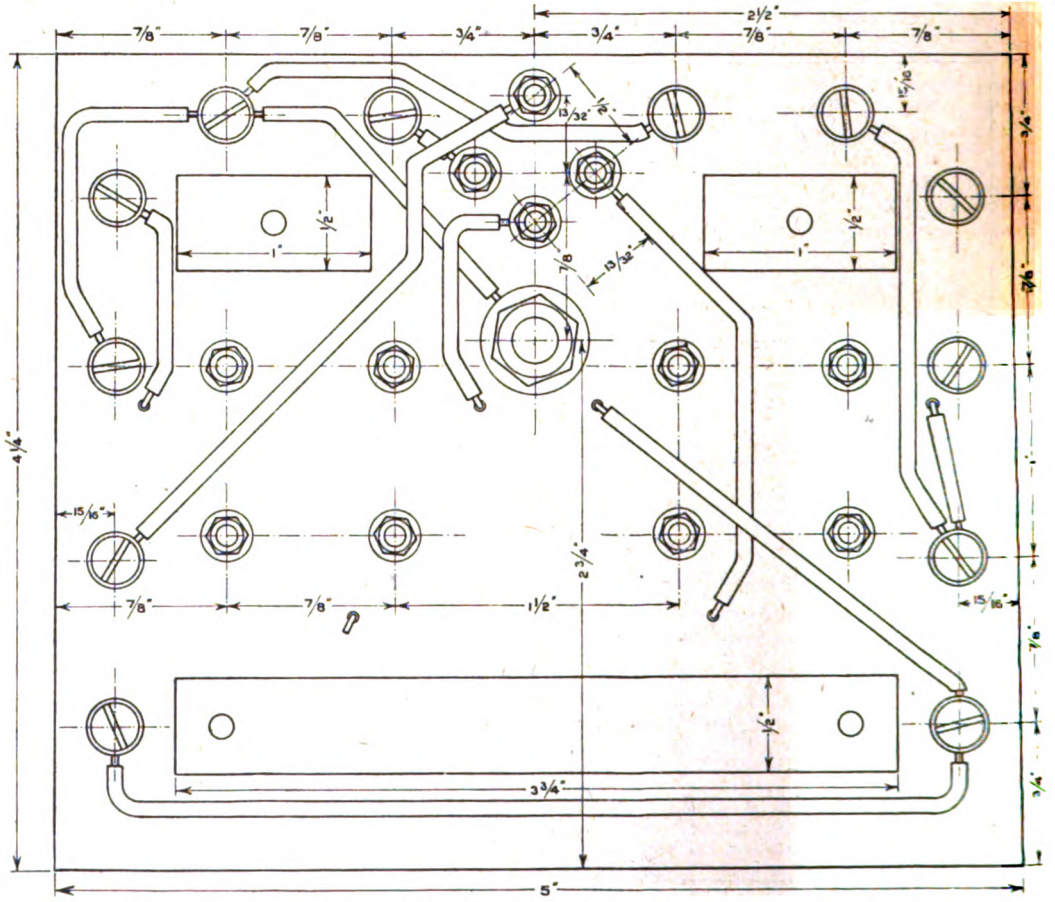
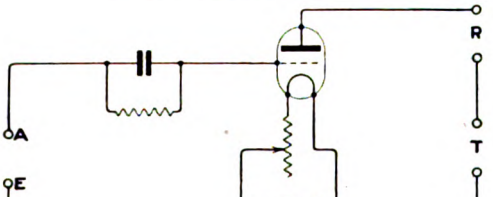



*Fig. 2. A view of the underside of the panel showing the wiring drawn to full size.*




*Circuit drawn in the form usually adopted in wireless circuit diagrams. The condenser across the telephone terminals is omitted.*

It is arranged by laying in with the plates of the condenser two additional strips of foil, one connected to either end, which, when assembled, will rest against the ebonite top. The pieces will be shorter than the plates and approach each other from opposite ends, leaving a ¼ in. in the middle space. Taking a pencil of medium hardness an area of about a square quarter inch is well pencilled over at either end of the condensers, on the points where the two short strips will rest. This pencilling is to make good contact with the strips. Between these points a uniform and unbroken line is made about 1/16 in. wide, which forms a leak path for charges acquired by the condenser.

Using No. 22 tinned or bare copper wire the various connections are made as shown in Fig. 2. These

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connections are also represented below Fig. 2 in the form usually adopted in wireless circuit diagrams. The "Sistoflex" tubing is fitted over the wire, giving a very neat appearance, ensuring perfect insulation, and helping to keep the wires in position. The leads passing out to the condensers are soldered to the ends of the copper foil with which they are wrapped.

Having put on all necessary nuts to act as terminals the instrument is complete except perhaps for the marking of the terminals. This can be done boldly with white enamel or, if a really smart instrument is desired, may be engraved by handing the panel over, carefully marked, to an engraver or firm undertaking such work, before the screws and other components are fitted. Engraving is filled in with a white wax, resembling sealing wax except in colour. No mention has been made of lacquering, and if the reader is acquainted with the process and cares to so treat the brass parts, the finish will be considerably improved. Lacquering will be dealt with in a subsequent article, in the description of instruments having a bigger display of brass.

F. H. H.

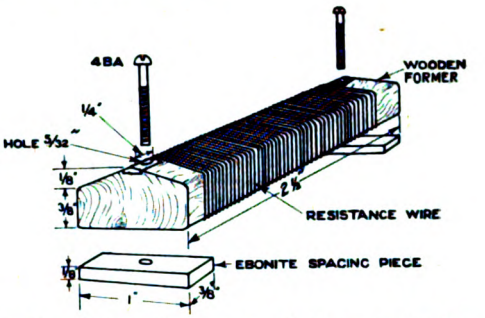



*Fig. 3. The wooden former, showing constructional measurements.*

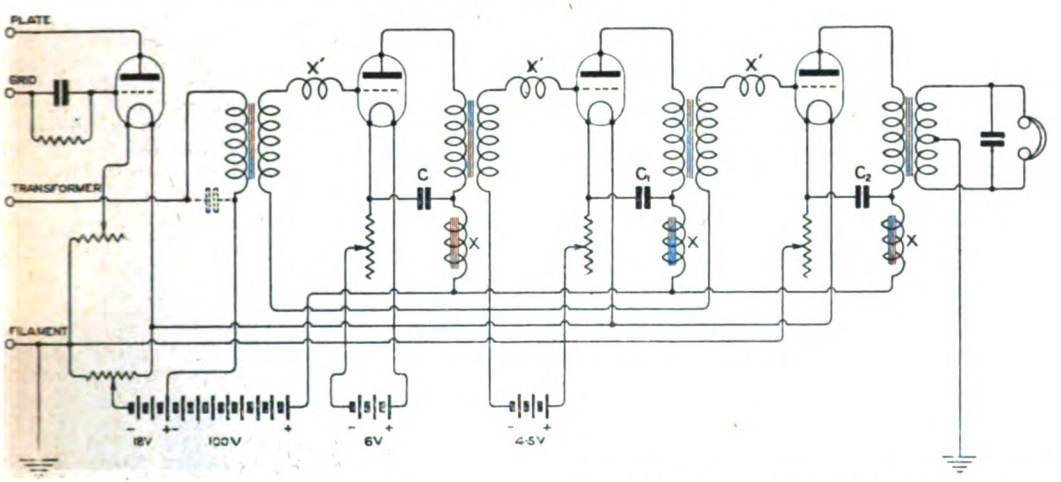
# Improvements in Audio Frequency Amplifiers

ANYONE who has tried to employ several stages of low frequency amplification soon discovers two things: first, the fact that noises are produced locally in the low frequency circuit itself, and second, that successive stages of amplification do not give the progressive increase in the strength of signals which one might be led to expect.

These objections to several stages of low frequency amplification are bad enough in the case of the amplification of telegraphy signals, but it becomes a far more serious matter where telephony and music are required to be amplified.

The ideal case would be that of an amplifier which through successive stages gives maximum amplification of the signals through each successive valve without distortion and without producing any reaction between one circuit and the preceding circuit.

The cause of the distortion of signals and absence of silence of the circuit is due principally to electromagnetic and electrostatic couplings between successive stages of amplification, and in addition oscillations set up in any one stage will tend to interfere with the amplification. If these oscillations are of audible frequency the circuit commences to howl, but there may also be high frequency oscillations produced which would not be readily detected.




In an article which appeared in a recent issue of "*QST*," Mr. H. E. Bussey describes improvements which he has applied to low frequency amplifier circuits for the purpose of controlling or preventing interaction between stages of amplification, comprising thorough shielding for both magnetic and static coupling effects by completely enclosing each stage, including the detector stage, with sheet

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steel. In the tests made 1/16th inch sheet steel was employed.

In proceeding with the experiments, as a means of gauging what effect the shielding had, an amplifier was first constructed without shields, but with arrangements made for the inclusion of shields if required. It was found that two stages of amplification without shielding were practicable, but the degree of amplification fell short of expectations. The shields were then inserted, the leads to each succeeding stage being taken through slots in the shields, and a remarkable improvement is stated to have resulted. The metallic shields themselves and the cores of the transformers were connected to the positive of the H.T. battery.

This shielding was found to effect a very considerable improvement, but interaction between successive stages was not entirely eliminated, and it was suggested that this was due to the coupling given by the H.T. battery. In order to overcome this, iron core chokes (X) were next inserted in the anode circuit of each stage and condensers (C) of the value of 1 microfarad as indicated in the accompanying diagram. It is stated that this arrangement gave a very marked improvement, it being possible to employ three stages of amplification under these conditions with greater silence of operation than had been possible with only two stages previously, and with a very marked increase in signal strength. It was arranged that each choke and condenser was included within the shield of the stage to which it belonged.

To prevent oscillation at high frequencies within stages a further refinement was introduced. This consisted of radio-frequency chokes (X′) inserted in the grid lead of each valve. These radio frequency chokes may consist of 25 turns of No. 32 S.W.G. double cotton covered, wound on a former of 1 inch diameter in single layer.

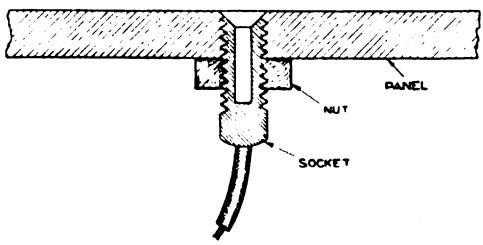
It is further recommended that telephones should not be inserted direct in the plate circuit of the last valve, but that a telephone transformer should be employed and the centre point of the secondary preferably earthed.

The condenser shown dotted in the diagram was not included in the diagram which appeared in "*QST*."

# A Simple Plug and Socket

By G. P. KENDALL, B.Sc.

ONE sees so many makeshift plug-in devices giving unsatisfactory service in amateur sets that one wonders greatly why so few experimenters have realised the potentialities of valve pins and valve socket legs. If they did but know it, they have here the ideal materials for making battery plugs and jacks, tapping plugs for H.T. variation, coil-holder plugs and sockets, plug-in devices for changing circuits in experimental sets and a host of other useful accessories. True, H.F. transformers are often fitted with pins to plug into ordinary valve sockets, but one does not begin to perceive the possibilities of the method until one starts to use the separate socket legs. With these as sockets it is easy to make up plugs and jacks having any number of "ways," and with the advantages of neatness, good contact and cheapness; also the sockets can be spaced well apart—a distinct advantage in some circuits.




*Method of mounting socket flush with top of instrument.*

The best appearance is obtained when the sockets are mounted flush with the surface of the panel, which can be easily done by threading the barrel of the socket and tapping the hole in the panel. The socket can be locked in position by means of a nut on the underside of the panel. It happens that the sockets are just the right size to take a quarter-inch Whitworth thread, and this serves fairly well; a finer thread would be better. To give a neat finish to the panel, fix the socket so that it projects very slightly above the surface. then, with a "rose-head" (or a ⅜" or ½" twist drill) reduce the socket to the section shown in the figure. Each socket is then in the middle of a little conical depression in the ebonite, which makes the insertion of the plug much easier.

## WIRELESS IN THE SICK ROOM.

The accompanying photograph, sent to us by the Rev. H. W. Doudney, shows his son enjoying the companionship of a wireless set during an illness when he was confined to his room.

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# Notes.

### Elimination of Static Interference.

Mr. J. H. Reeves reports, apropos of his remarks on X's, June 29th, 1.00–1.30 B.S.T., while the thunderstorm was raging he listened-in on 600 and could read **FFU** with only occasional loss of a letter.

### Coming Conference of Government Representatives.

In the House of Commons Mr. Pike Pease stated that the Canadian Government will shortly send two technical representatives to discuss the whole subject of the Empire wireless chain with representatives of his Majesty's Government.

### Amateur Telephony Transmission.

A Doncaster reader states that he is receiving very good telephony from **2 ND** and **2 GJ**, and is desirous of being informed of their location. He further says that the speech and music on 280 metres is the finest he has heard.

### Equipment for American Army Aeroplanes.

America's Army aeroplanes are soon to be equipped with radio apparatus claimed to be the best in the world.

Service machines are to be equipped with new sets capable of transmitting both telegraph and telephone messages during flight to the ground, or from machine to machine in the air. The new sets are of three types, designed for pursuit, observation and bombing aeroplanes, and are the latest development of the Signal Corps Radio Section. Although the specifications have been drawn up and tenders invited by the Signal Corps, no description of the new equipment has been released. It is said, however, that they are a big improvement on the sets now in use in the American Army Air Service. The largest and strongest set, S.C.R. 135, designed for bombing planes such as the dual-engined Martins, will have a telephone radius for machine-to-ground of about 75 miles, and a telegraph radius from machine-to-ground of about 200 miles.

For pursuit machines, S.C.R. 133 is designed to give a reliable telephone radius for aeroplanes in flight up to 5 miles. Set 134, for observation machines, like the DH-4's, will ensure radio-telephony between two aeroplanes on the wing up to about 10 miles. The largest sets which are to be installed in the Martins, it is expected, will make aerial conversation possible up to 25 miles. In aerial work a trailing antenna is used as an aerial, and for ground work the metal parts of the plane.

Previously, radiophone messages have only been carried on between aeroplanes over short distances as in "voice-control" flying, where the commander of a squadron directs the manœuvres of his pilots, but with the new sets officers of the Army Air Service hope to employ radiotelephony to a greater extent and see far larger applications of radio in flying operations.

### Receiving Sets for Broadcasting.

Mr. J. R. Schofield, of the South Wales Wireless Training College, Cardiff, in a letter to the *South Wales Daily News*, says:—"Having had numerous inquiries and offers to purchase receiving sets, and inquiries *re* the kind to purchase, I strongly advise merchants and private buyers not to purchase any kind of instruments until the Government and manufacturers have agreed on a standard wavelength, otherwise they will be loaded with worthless goods and have to purchase numerous accessories. I turned down an offer last week to purchase 250 sets, knowing the present state of things. When broadcasting sets are purchased, buyers would be well advised to buy only the instruments of recognised makes. Cheap goods prove the dearest in the end, and never give the best results."

### Civil Engineers' Conversazione.

Mr. W. B. Worthington, President of the Institution of Civil Engineers, received the guests at the Annual Conversazione held on June 27th, at Great George Street.

A lecture was given by Capt. H. Riall Sankey, on "Broadcasting," who demonstrated by the aid of old and new apparatus by the Marconi Company. Engineering models and scientific devices were placed round the library for inspection.

### Transmission by Air Ministry.

The Air Ministry notifies that:—

(1) With effect from the 1st July, the Synoptic Reports and General Inferences issued on 1400 metres C.W. by Air Ministry daily at 0600, 0800, 1400 and 1900 (G.M.T.); and 0915 and 2000 (G.M.T.) respectively will be transmitted on 4100 metres C.W. The Synoptic at 0200 will continue on 1400 metres as hitherto. The 0830 report will cease.

(2) In cases where breakdown of the main set, or other delay in commencing transmission on 4100 metres is occasioned, should transmission not have been commenced at the expiration of ten minutes, the message will be issued on 1400 metres commencing at ten minutes after the routine hour.

### Telephony Transmission.

Marconi House **2 LO** hopes to carry out telephony transmission tests as follows:—

7th July, every alternate 20 minutes from 5 to 8 p.m. 10th July, 2.30 p.m. 11th July, 7.30 to 8.30 p.m. 12th July, 5 to 5.20 p.m., 6 to 6.20 p.m., 7.30 to 8.30 p.m. 20th July, 8 to 9 p.m.

### Imprisonment for Fraud.

William Parsons, a dental mechanic, of Bayswater, pleaded guilty at the Marylebone Police Court on June 29th, to a charge of being in the supposed unlawful possession of a number of postal orders, a cheque and a money order, and obtaining two guineas by fraud from Leonard William Sims. It was stated that defendant had advertised for sale "ten-guinea wireless sets for two guineas," in the name of Messrs. Barkers, Ltd., Queen's Road, Bayswater, which was an accommodation address. Inquiries were made by the police, and it was found that he was not in a position to supply the sets. A sentence of six months imprisonment in the second division was passed.

This case should serve as a caution to those about to purchase wireless sets. Not only does the sudden demand for apparatus bring with it opportunities for fraud, but also provides a field for

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the sale of equipments of uncertain reliability. Purchasers are advised to see the apparatus actually working on an aerial of similar dimensions to the one they propose to instal, or if ordering through the post, a guarantee that the apparatus will function correctly under the conditions for which it is required, should be asked for.

We take this opportunity of advising our readers that every care is taken to ensure, as far as is possible, that apparatus advertised in the journal is reliable, and that the firms offering it can be depended upon for fair dealing. In this connection we shall be indebted to readers for bringing to our notice any instances of unsatisfactory treatment by our advertisers.

**The Institution of Electrical Engineers: Wireless Section Committee, 1922-23.**

The following members have been nominated to serve on the Wireless Section Committee for 1922-23:—Chairman: Professor G. W. O. Howe. New nominations for membership of the Committee: Mr. S. Brydon, Mr. J. St. Vincent Pletts, Captain H. R. Sankey, C.B., C.B.E., R.E., and Mr. R. L. Smith-Rose. The following will continue to serve as members of the Committee: Mr. B. Binyon, O.B.E., Mr. R. C. Clinker, Dr. W. H. Eccles, Professor C. L. Fortescue, Mr. G. H. Nash, C.B.E., Mr. C. C. Paterson, O.B.E., Captain H. J. Round, M.C., Mr. L. B. Turner. Other nominations may be made within fourteen days of the publication of the Committee's list.

**Long Distance Amateur Reception.**

Mr. F. Dillon Bell, of Otago, New Zealand, states that he is frequently able to get **LY** (Bordeaux) on a single valve, and with three valves **IDO, POZ** and all the louder U.S.A. stations can be heard. The apparatus used by Mr. Bell is of Burndept manufacture and Burndept coils are used.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—An error in your reply to the query of "Radio-Lantic" (Newark), in the May 6th issue of your paper, has just come to my attention, and for the benefit of others interested the following information is submitted.

During the war all commercial stations in this country were taken over by the Navy Department and were thus allotted calls with the Naval prefix "N." In this manner New Brunswick became **NFF** and kept this call until the station was returned to the Radio Corporation of America, at which time the call became **WII**, although still appearing in some of the older lists as **NFF**.

The station at Tuckerton, New Jersey, appearing on the call lists as **NWW**, its Naval call, now has two transmitting units with the calls **WGG** and **WGI**.

For those of you who are keen on long distance reception on the higher wavelengths the reception of the Radio Corporation's Trans-Pacific stations should afford a good test of an efficient receiver. The Pacific Coast end of this link is a 200 kW. alternator unit, situated at Bolinas, California, working on 13,100 metres, call letters **KET**, in communication with two other transmitters of the same power at **Kahuka**, Island of Ohau, Territory of Hawaii, working on 16,975 and 16,435 metres, call signs **KIE** and **KGI** respectively.

G. A. BURNS.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—It would appear that, in view of the rapid extension in the use of wireless apparatus by private individuals, we shall soon be requiring some distinct type of classification between technical and non-technical "amateurs."

Up to the present time the so-called wireless amateur has, as a general rule, been an individual displaying considerable skill in the utilisation of his instruments, and having very high technical knowledge. From now onwards there will enter into the field a large number of wireless enthusiasts who are much more interested in hearing music and signals than in carrying out experimental and research work, and it would appear that it will be necessary to find some sort of a name under which to head these individuals if the private technical enthisiasts are still to be called amateurs. No doubt some of your numerous readers will be glad to offer suggestions for a suitable name.

At any rate, Mr. Editor, I am sure the ingenuity of some of your staff will solve the problem so that in discussions in the future no confusion may exist between the two very distinct classes of amateur wireless enthusiasts.

Yours faithfully,

**2 WQ.**

# Calendar of Current Events

**Saturday, July 8th.**

WANDSWORTH WIRELESS SOCIETY.

Field Day.—Outing to Box Hill.

**Sunday, July 9th.**

Transmission of Telephony from 3 to 5 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, July 10th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7.30 *p.m.*—Annual Meeting for election of officers.

**Tuesday, July 11th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT** Writtle, near Chelmsford.

**Friday, July 14th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Lecture on "Maritime Radio Communication," by Mr. D. E. Pettigrew.

**Sunday, July 16th.**

Transmission of Telephony from 3 to 5 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY.

Field Day.

**Monday, July 17th.**

LEICESTERSHIRE RADIO AND SCIENTIFIC SOCIETY.

General Meeting, Vaughan Cottage, Leicester. Lecture on "Continuous Wave Transmission," by Mr. J. W. Pallett.

**Tuesday, July 18th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT** Writtle, near Chelmsford.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### The West London Wireless and Experimental Association.*

Club-rooms, Belmont Road Schools, Chiswick, W.4.

Hon. Secretary, Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

On Thursday evening, June 15th, the members of the Association had the pleasure of hearing its Vice-President, Mr. F. E Studt, read his paper entitled "Interpretation of Wireless Circuits"

The subject is one that is of great educational value and assistance to the wireless amateur. The lecturer having drawn a single valve circuit diagram on the board, commenced with the aerial circuit and explained most minutely the functions of each small part of the circuit throughout. The other individual circuits. collectively forming the whole circuit were in turn dealt with, and expounded carefully and to the fullest extent—owing to the length of the subject the lecturer was unable to conclude the paper and this will be continued at a subsequent meeting. It is hoped that members will have the opportunity of visiting the Slough Experimental Station at an early date. The Secretary will be pleased to reply to all applicants for part culars of membership and objects of the Association. Members are still rolling in so that they will be more versed in the science of wireless by the time "broadcasting" comes into operation.

### Wakefield and District Wireless Society.*

A meeting of the Society was held at the Y.M.C.A., Grove Road at 8 p.m., June 16th, when the Chair was taken by the President, Mr H. H. T. Burbury.

After the minutes had been read by the Secretary, Mr. Ed Swale, the Chairman, after a few remarks, called upon Mr. Swale to give his lecture on "The Tuner," and by the means of diagrams on the blackboard he explained the characteristics of the tuner, much to the interest of all present who numbered 42, including two ladies.

Instruments were passed round for inspection. The Chairman moved a vote of thanks both to the lecturer and to members who kindly brought apparatus which contributed to making the meeting such a success. The motion was carried with enthusiasm.

All desirous of becoming members are invited to communicate with Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Wakefield.

### The North London Wireless Association.*

Hon. Secretary (pro tem.), Mr V J. Hinkley, Northern Polytechnic Institute, Holloway, N.7.

At a meeting of the above, held on Monday, June 19th, a very successful demonstration of telephony was given, the station **2 VW**, run by one of our members, specially transmitting for the occasion.

Our friend at **2 VW**, besides having time for experimental wireless, also turns his attention to music and gave selections on the cornet, tin whistle, and flute, which instruments, having a considerable range of pitch and quality, proved a good test for modulation.

The Association will welcome any inquiries from prospective members addressed to the Hon. Secretary as above.

### The Dewsbury and District Wireless Society.

Hon. Secretary, Mr. A. Horsfall, Willow Grove, Lee Street, Ravensthorpe, Dewsbury.

On Thursday last, June 8th at 7.30 p.m., the above Society opened its new rooms in South Street, Dewsbury, by an open meeting and lecture, the President, Mr. S. S. Davies, presided.

Mr. Yardley, of Leeds, was to have lectured but was unable to attend, and the Society was very fortunate in being able to obtain the services of Mr. Denison, of Messrs. Denison Bros., Halifax, better known as **2 KD.**

His lecture was illustrated by blackboard diagrams, and dealt chiefly with the erection of aerials, the working of thermionic valves, and reception on short wavelengths. It was a most instructive and interesting lecture, especially the latter, in view of the reduction in the amateur wavelength.

At 8.30 p.m., according to programme, music and speech was picked up (transmitted by Mr. Burbury, of Crigglestone, **2 AW**), and was audible all over the room.

At the close of the meeting the usual vote of thanks was expressed to the speaker (Mr. Denison), and Mr. Burbury who so kindly sent the transmission.

Almost 100 persons were present, and although the Society is only four months old, 50 members have been enrolled to date.

The members have been informed that the Club-rooms will be open on Tuesdays and Thursdays. Club night is Thursday.

Prospective members will be welcome at the Club-rooms on Thursday evening. Further particulars from the Hon. Secretary.

### Smethwick Wireless Society.

Hon. Secretary, Ralph H. Parker, Radio House, Wilson Road, Smethwick, Staffs.

The above Society held its annual meeting on Friday, June 2nd. A statement of accounts was submitted by the Treasurer which showed that the Society was in a very satisfactory position financially The report for the year was read by the Secretary, and the following officers were elected :—President, Mr. R. W. Hutchinson, M.Sc., A.M.I.E.E., F.R.G.S., F.G.I.; Vice-Presidents, Mr. A. Adams, F.G.S., Mr. A. J. Hulme, Mr. J. Stoney, B.Sc., A.M.I.M.E., Mr. C. Grew, Mr. H. Garrett, B.Sc., Mr. Sidney D. Waltho, Major Thompson, Mr. S. W. B. Stephens, Mr. McKale; Secretary, Mr. Ralph H. Parker;

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Assistant Secretary, Mr. L. Lee; Treasurer, Mr. A. Allen; Committee, Messrs. Bryant, Sessions, Whitehouse, Kay Evans, Ben.

It was also decided to apply for affiliation. During summer months meetings will be held monthly.

On June 30th, Mr. L. Lee, of the Smethwick Technical Institute, lectured on telephony

### Leicestershire Radio and Scientific Society.

The monthly meeting of the Leicestershire Radio and Scientific Society took place on Monday, June 19th, at headquarters.

The balance sheet of a recent dance was read and accepted, it showing a substantial profit of £5 2s. 5d.

Three new members were accepted, bringing the total to 43 members.

The lecturer for the evening was the Society's President, Mr. Cyril T. Atkinson, and the subject, "Short Wave Reception." Mr. Atkinson first of all pointed out the reasons for the special measures necessary for short wave receiving the short aether waves of below 300 metres, and then described, step by step, the various classes of gear and methods of construction.

The lecture was illustrated by a number of pieces of apparatus of the lecturer's own construction, and an extremely interesting evening was spent.

At the conclusion a very hearty vote of thanks was accorded to the lecturer, proposed by Mr. Pallett and seconded by Mr. Yates, being heartily acclaimed by the whole assembly.

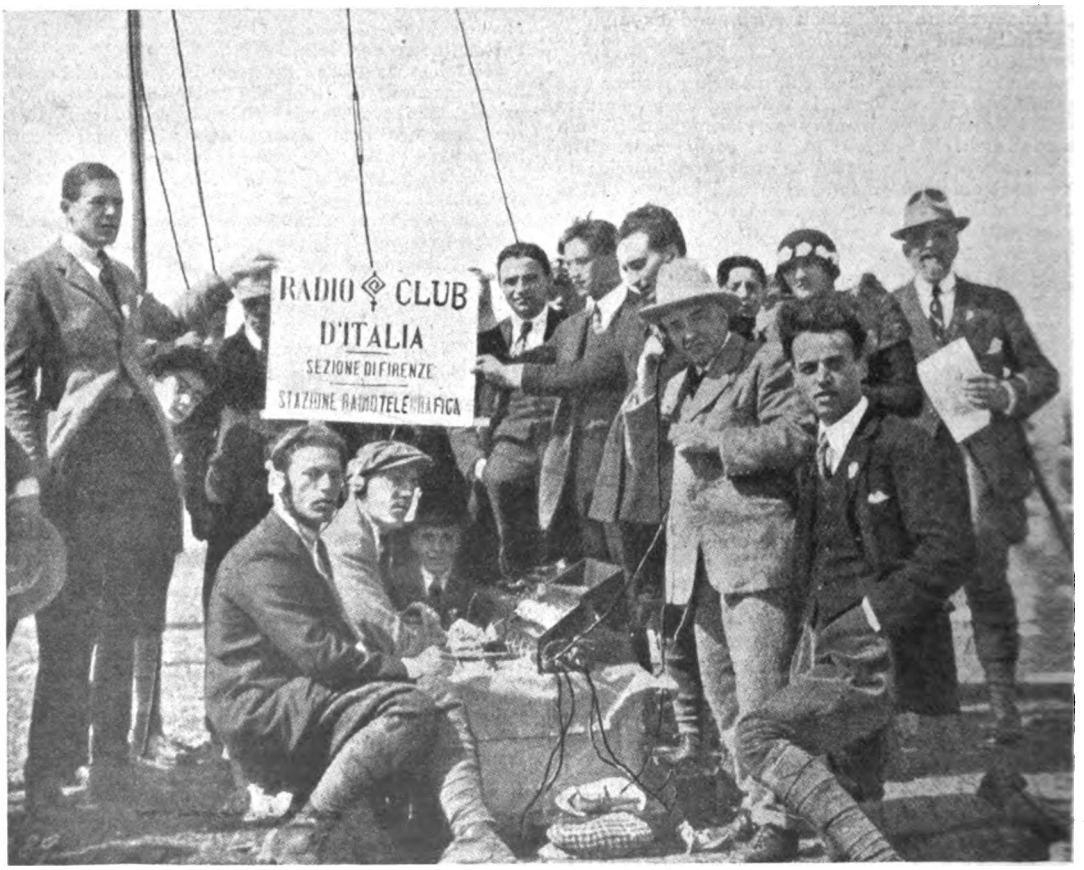
The meeting closed at 9.30.

Secretary, Mr. J. R. Crawley, 269, Mere Road Leicester.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society was held on Wednesday, June 14th, at Kingsland Assembly Room. A large gathering was present and an enjoyable evening spent. Mr. Bateman demonstrated on his "single valve set," on which, by the way, he receives the Hague very loud and clear. A special message sent out by the Hague to the secretary of the above Society was logged by him and forwarded to the Secretary for confirmation. He also received by telephony the result of the Derby. Mr. Bateman is an ex-soldier, and having the use of only one hand is greatly handicapped. He has only taken up wireless two months, and has




*Portable Station of the Radio Club d'Italia on Monte Morello.*

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belonged to the above Society during that time. Great credit is due to him for the rapid advancement he has made.

All questions asked Mr. Bateman were answered with satisfaction. Buzzer practice brought the evening to a close. The Club is now open to accept associate members. Full particulars will be sent on application to the Secretary.

### Wolverhampton and District Wireless Society.

A Committee meeting of the above-named Society was held at Headquarters, 26, King Street, on June 12th, Mr. H. H. Speke in the Chair. The chief item on the agenda for discussion, was the arrangement of a programme for future meetings. Messrs. D. Baker, H. Taylor, and Geo. W. Fairall, members of the Committee, who have transmitting stations, suggested a visit of members on June 28th, to see them. This idea was gladly received and adopted. A general meeting was held on June 13th, when Mr. Blakemore, A.M.I.E.E., delivered the third and last of his series of lectures, the subject being "Electrical Terms and their Meaning." With practical demonstrations in static and current electricity the lecturer held the attention of his audience from beginning to end. At the conclusion of the lecture the hope was expressed that Mr. Blakemore would again favour the Society at an early date. An invitation was then extended to members, to visit the stations of Messrs. D. Baker, H. Taylor, and Geo. W. Fairall, and names taken of those members who were able to accept. In addition to the visitation a general meeting will be held at Headquarters, 26, King Street, on June 28th, at 8 o'clock. Buzzer practice at 7 o'clock.

Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

### The Hackney and District Radio Society.

The first general meeting to discuss the formation of a Radio Society, was held at 111, Chatsworth Road, Clapton, E.5, on Thursday, June 8th.

It was decided to carry out all activities under the above title. Being the first meeting the members were more or less strange to one another. The good number of the attendance was surprising.

Officers were elected as follows:—Mr. D. Street, Chairman; Mr. E. R. Walter, Secretary; Messrs. Douglass, R. Ison, A. Valin, F. Jenkins, A. V. Morgan, T. Kiernan, Committee.

Several resolutions were passed which the Committee considered after the meeting, so as to bring into motion at the next meeting A general conversation took place, which ran into many interesting subjects on Wireless. Mr. A. Valin exhibited some high frequency transformers.

It was decided to start a Morse class, and instructional help to members who are young with the subject, at the meetings on every Thursday, at 8 p.m.

The second meeting of the above Society was held on June 15th, at 111, Chatsworth Road, Clapton, Mr. D. Street in the Chair. The minutes of the previous meeting were read and confirmed. Further arrangements for the management of the Society were discussed, and a list of rules and regulations was compiled This was read and confirmed at the next meeting, on June 22nd, at the above address.

Morse practice was carried out. The meeting was of an informal nature. Wireless instrumental parts, chiefly condensers and coils apart were produced. The major part of the conversation was concerning the making and sizes of efficient broadcasting coil.

All enquiries should be addressed to the Secretary, Mr. E. R. Walter, 48, Dagmar Road, South Hackney, who would also be glad to receive catalogues.

### Ilford and District Radio Society.

On Thursday, June 15th, our Chairman, Mr. H. H. Lassman, gave a lecture on "A Single Valve Receiver."

The lecturer first dealt with the subject from the point of view of apparatus required, the functions of each individual part, and built up the circuit in diagram form.

The making of the set was then explained, suitable values of leak and condensers and sizes of coils for the 440 metre wave were given. The general working of the set was detailed and many hints and precautions given. A large number of questions were asked, and a very lively discussion arose on the size of coils required, and the best form to be used for the 440 metre wave. The merits of every form of coil were discussed and easy methods of making described.

The Society has pleasure in announcing that Mr. Fredk. Wise, M.P., and Mr. W. W. Burnham have very kindly consented to become Vice-Presidents of the Society.

A series of junior constructional classes is being run under the supervision of Mr. F. C. Grover. This should be of particular interest to those just starting.

Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

### Tunbridge Wells and District Wireless Society.

On Wednesday, June 7th, the Society, which has changed its address to 81, Calverley Road, Tunbridge Wells, accepted the kind invitation of Sir Robert Gower to visit him at Sandown Court, on the outskirts of Tunbridge Wells.

After inspecting the large new aerial which had recently been erected, the party adjourned to the house to listen-in to the Marconi Concert. This was successfully picked up and rendered audible to all present by means of a Marconi M16 receiver, four-valve amplifier and loud speaker.

Sir Robert, after a short interval for refreshments, exhibited further apparatus supplied by W. R. H. Tingey (unit system), in which five valves were employed, followed by a Brown's relay and loud speaker. Considerable interest was shown by the visitors in the tuning arrangements and the remarkable powers of amplification possessed by this set.

The Marconi receiver and amplifier previously referred to, were then formally presented to the Society. Mr. G. W. Howard, the President, on behalf of the members, expressed his thanks and great appreciation of their host's generous gift. He stated that it supplied a long-felt want, and he was sure that it would assist the Society in its endeavours to obtain new members.

Amateurs in the district who may wish to join the Society should apply to the Hon. Secretary, Mr. W. P. Burrin, 86, Stephens Road, Tunbridge Wells.

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### The Watford Grammar School Wireless Society.

A Society has recently been formed at the above school, membership being open to the senior scholars. At the inaugural meeting the following officers were elected:—President, H. Nicholson, Esq., M.A.; Vice-President, A. H. Cooper, Esq., M.Sc., B.A.; Hon. Secretary, Mr. J. W. Crichton. The activities of the Society are under the direction of the officers who are assisted by a small committee.

A General Meeting was held on May 15th, Mr. A. H. Cooper was in the chair, and the general business having been completed, he introduced Mr. Paul D. Tyers who was to open a discussion on "The Valve as a Detector of Damped Waves." The function of a valve as a detector was illustrated by means of a number of experiments, the necessary apparatus being supplied by the school science department. A number of curves were made during the evening, the actual anode currents and grid potentials being made visible by means of large scale meters mounted on the wall. At the close of the address Mr. Paul D. Tyers expressed his thanks for the way in which his remarks had been received and stated that he was indebted to the Marconi Scientific Instrument Co. for supplying a large number of the slides which he had been able to show them.

The interest in the Society is increasing, and it is hoped to arrange a definite programme very shortly. The Society has in its possession an excellent aerial and a large amount of apparatus. Listening-in is a regular feature among the members and many are becoming expert with the Morse code.

Hon. Secretary, Mr. J. W. Crichton, Watford Grammar School.

### Cercle Anversois d'Etudes de T.S.F.

This Society, recently formed in Antwerp, comprises already some sixty-five members, and has succeeded in obtaining the Physics Lecture Theatre of the Lycée d'Anvers for its meetings and lectures. A monthly bulletin is being published, the first copy of which was due to appear the beginning of June. They will be pleased to insert any important communication emanating from either amateurs or societies in England, and invite correspondence on wireless matters. Some of the Antwerp amateurs possessing very complete apparatus, the Secretary wishes to get into touch with British amateurs possessing transmission licences in view of proceeding to some trans-North Sea tests, the importance of which will no doubt appeal to readers. The Belgian amateurs hope that they will be granted transmission licences shortly.

At present informal meetings are held, and a course of lectures on apparatus construction and electricity and wireless has been started.

Anyone interested should write to the Secretary, Mr. A. Wust, A.C.G.I., Engineer-in-Charge, Central Station of the Société d'Electricité de l'Escaut, Merxem-Antwerp.

### Cannock and District Wireless Society.

At a meeting held on June 5th it was decided to form the above Society. Mr. G. M. Whitehouse was elected chairman and Mr. T. Ball, Secretary. A good membership is expected, and affiliation to the London Wireless Society has been applied for.

### Proposed Wireless Club at Deptford.

Mr. Henry C. Cook is desirous of forming a Wireless Club under the name of "The New Cross and Deptford Radio Society." He has two first-class sets of instruments with a loud speaker, a 90 ft. mast and a generator for charging batteries, which he will place at the disposal of the Society, with a club-room and necessary fittings.

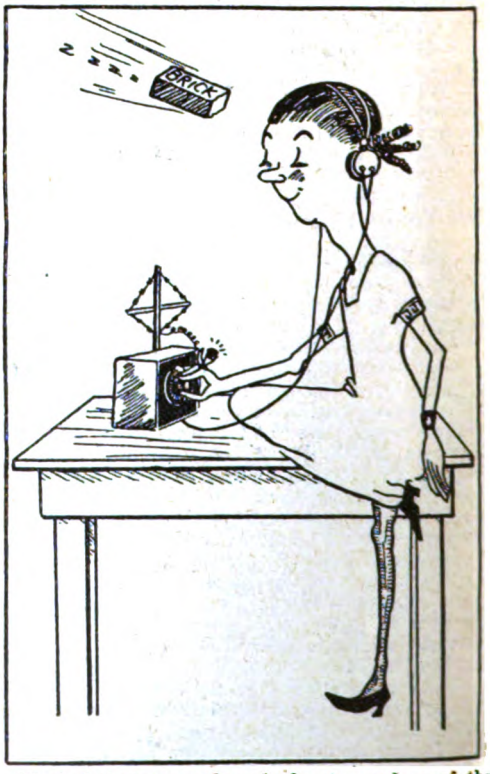
### Clapham Park Wireless Club.

Mr. J. C. Elvy, A.M.I.E.E., M.I.E.S., 3, Fontenoy Road, Bedford Hill, S.W.12, will be glad to hear from amateurs in the Clapham Park district with a view to their co-operation with him and a number of others in the formation of a wireless club.

### Bedford and District Radio Association.

Mr. C. W. Clarabut, of Beverley Crescent, Bedford, is making an effort to establish a Radio Association in his locality. He finds it difficult to get in touch with actual manufacturers of radio accessories such as condenser plates, contact studs, terminals, switch-knobs, etc. Those interested should communicate direct to Mr. Clarabut.

### OUR PICTURE OF THE WEEK.




We feel that an apology is due to readers of the *Wireless World* for our remissness in not previously publishing the type of wireless picture that is so popular with our contemporaries. The defect is hereby remedied with acknowledgements to the American wireless magazine *QST*, from which the drawing is taken.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"C.G.B." (Wimbledon Park),** *with reference to the Reinartz Tuner, asks (1) Will the winding for 600 metres tune down below 400 metres. (2) The size of windings for a range of from 300 to 600 metres. (3) If any tappings are required in either aerial coil or grid coil. If so, how many. (4) What other types of valves besides a QX will be suitable.*

(1) Not as shown. It is intended for the 600 metres only. (2) and (3) A 70-turn coil would probably cover this range if provided with aerial and earth taps of approximately the same number and proportionate size as those in the original receiver, but it would be safer to increase the size of the coil to about 80 turns. The exact number will have to be determined by experiment. (4) Almost any hard valve.

**"SPARKS" (Birmingham)** *asks (1) For a diagram of a two-valve circuit. (2) Could he get* **PCGG** *with a two-wire aerial 30 ft. high. (3) Could he make a reaction coil. (4) What would the inductance of a basket coil be wound with 44 turns of No. 30 S.C.C. wire.*

(1) See diagram. (2) Doubtful, but possible. (3) Yes, a reaction coil is made in exactly the same way as any other coil. (4) The dimensions given for the coil do not appear to be self-consistent. Assuming the number of turns is correct as stated, the inductance would be approximately 300 mhys.

**"W.H.S." (Sutton-on-Sea)** *gives a list of apparatus and asks if this is complete, and how to connect up the various pieces. (2) Is it necessary to have a licence before purchasing apparatus.*

(1) The apparatus suggested would be sufficient, but a grid condenser and leak would be an advantage. Connect up as in diagram. (2) No, but a licence must be obtained before the apparatus is used.

**"W.H.K." (Hurlingham)** *asks (1) How to add an L.F. amplifier to a circuit sketched. (2) How to add an H.F. amplifier to the circuit without alteration, if possible.*

(1) In spite of the way in which the diagram is arranged this circuit is of quite ordinary type. The additions required will make the circuit essentially that of Fig. 3, page 340, June 10th issue, H.R. telephones being retained if required.

**"B.D.C." (Chepstow).**—The circuit is O.K., and should give most of the stations you suggest, but we doubt if you will get useful results with **2MT.** The maximum wavelength is probably not less than 3,000 metres, but we cannot give the actual value as you do not state the capacity of the A.T.C. A condenser across the telephones would improve the set. There is probably not much difference between the telephones you mention, though with equal design and workmanship 4,000 ohm telephones would be better than 2,000 ohms.

**"R.P.H." (Parkstone)** *gives a diagram and asks (1) Are the connections correct. (2) Would a reaction circuit improve the results.*

(1) The circuit is quite O.K. (2) Reaction might be used to increase the range, but great care should be taken if this is done to prevent the set from oscillating.

**"BEGINNER" (Hampstead)** *asks (1) For a single valve circuit using basket coils. (2) What range would it have with an indoor aerial 80 ft. long of No. 26 enamelled copper wire. (3) Does the markings on Sullivan's 120 ohms headgear receivers mean the resistance of each ear-piece or the two together.*

(1) See diagram (Fig. 1). (2) It depends on the power and wavelength of the transmitting station, and also how badly the receiver is shielded by the walls of the house. It is impossible to give any useful figures. (3) 120 ohms is the total resistance of the pair.

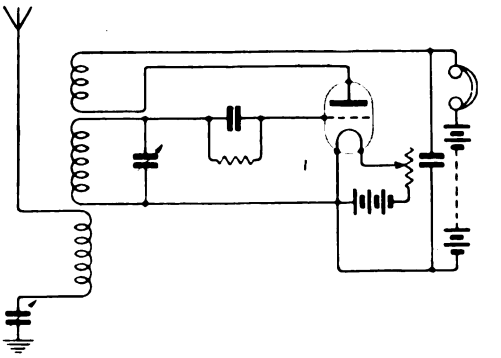

*Fig. 1.*

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**"H.E.C." (Kentish Town)** *asks for a diagram of a resistance coupled circuit, using two R type H.F. valves followed by crystal rectification and one R type L.F. valve, and giving the respective values of the resistances of condensers required.*

See diagram. (Fig. 2.)

**"H.B." (Forest Gate)** *wishes to construct a frame aerial for 350 metres and asks* (1) *Size of frame.* (2) *Number of turns and size of wire.* (3) *Is the shape sketched correct.* (4) *Where to connect the two ends of the winding.*

(1) About 3 ft. square. (2) Six turns, spaced 1 cm. apart of about No. 18 wire. (3) This type will be satisfactory. (4) Across the terminals of a small variable condenser, which itself is connected across the grid and filament of the first valve.

*and asks* (1) *How he can estimate the capacity of the aerial to get 0·00035 mfds.* (2) *What should be the capacity of the A.T.C.* (3) *For a diagram to supplement the Figs. 3 and 9 of this article showing connections.*

(1) Accurate computation of the capacity of an aerial is a lengthy and difficult process. You will find the method described in Nottage's "Calculations of Inductance and Capacity." The value of 0·00035 mfd. is somewhat high for a P.M.G. aerial. Yours will probably be rather less, giving you a somewhat smaller maximum wavelength. (2) See page 350 in the article referred to. (3) The amplified diagrams you ask for are given in figures 8a and 8b of the article. We think these are about the only useful simplifications of Fig. 9 which it is possible to make.

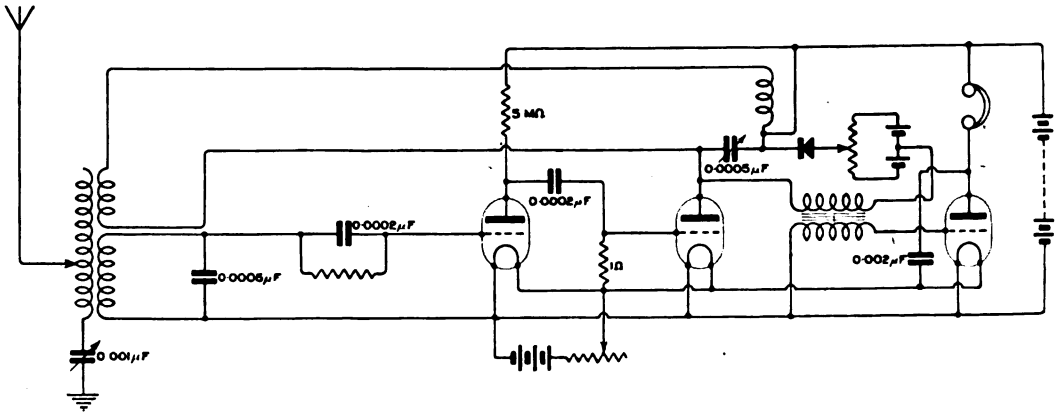


*Fig. 2.*

**"AFICIONADO" (Madrid)** *asks* (1) *The gauge of a sample of wire.* (2) *If this would be suitable for a reaction coil of a single valve receiver described in February, 1921.*

(1) No. 36. (2) Yes, provided about the same number of turns are used, that is 50 and 200 for the two sections.

**"H.M.R." (Newcastle-on-Tyne)** *submits a diagram of four-valve set with jacks for switching in one to four valves and asks* (1) *If satisfactory.* (2) *How many foils and what size with mica 0·002" thick, and 2" × 1½" for condensers of capacities 0·0003, 0·001 and 0·004 mfds.* (3) *If certain data for an inter-valve transformer will be correct.* (4) *For information about certain coils.*

(1) Yes, except that jacks used for H.F. in this way lead to a certain amount of inefficiency, and are liable to oscillation owing to the capacity of the jacks and the connections. (2) For 0·0003 mfd. two foils 1 cm. wide, overlap 2 cms. For 0·001 two foils, 2 cms. wide, 3 cms. overlap. 0·004 mfd. five coils, 2 cms. wide, 3 cms. overlap. (3) Quantities suggested and size of formers O.K. (4) We should advise making reaction coil to slide within the other former if possible. If so, probably 100 turns sufficient. If not, wind it full. Re-wind the tuning former with about No. 30.

**"HINAIDO" (Portsmouth)** *proposes to construct a set described in the issue of September, 1921,*

**"W.H.T." (Newcastle)** *sends a diagram of his set and asks how it could be improved for the reception of telephony.*

The set is of quite good type and not capable of any considerable improvement. We dislike, however, the L.F. reaction shown, which is liable to produce distortion and howling. The fact that the grid leak has no effect points to the insulation of the valve holder being defective to an extent which is probably enough to weaken your signals.

**"A.C.M." (Woolwich).**—We regret having no information regarding the receiver you describe.

**"A.C.R." (Blackpool)** *asks why he gets signals on short wave by putting his hand on the top of the tuning coil.* (2) *How to construct honeycomb coils on a former 1½" × 1¼"—the number of pegs and number of turns for each coil.* (3) *A suitable reaction coil for use with the above.* (4) *Should he get* **2 MT** *or* **FL** *telephony on a single valve.*

(1) The effect is practically equivalent to the rearrangement of set on the lines of the diagram, which should, and evidently does, tune the set to a much lower wavelength than is obtained with the additional earth removed. (2) 15 pegs required. Try number of turns as follows: 40, 80, 150, 250, 400, 600, 1,000 and 1,500. (3) For the reaction use the coil next smaller than the one in use for tuning. (4) **2 MT** very doubtful; **FL** possible.

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**"WIRELESS BUG" (Brighton)** *asks* (1) *How to renovate Perikon crystals.* (2) *Whether* LP *now transmits telephony on* 2,500 *metres. If so, at what times.* (3) *If a P.O. telephone relay,* 500 *ohms, can be used in conjunction with* 150 *ohm telephone receiver for a loud speaker.* (4) *What is the wavelength used by aeroplanes calling Croydon, and why the noise of the engines does not interfere with their speech.*

(1) The only thing that we can suggest is to take them out of the mountings (*i.e.*, by careful application of heat) and turn them into new positions and search for new sensitive regions, or careful chipping to expose new surfaces, afterwards remounting them. (2) We regret we have no knowledge of telephony transmission by this station. (3) We are afraid this instrument would not be of much use for this purpose. (4) 800 to 1,000 metres. Careful arrangements of various types are made to make the microphone respond only to the localised sound of the operator's voice and not to the general distributed noise of the engine of the machine. The problem is similar to the use of a speaking-tube in a very noisy building, which is quite practicable.

**"J.W.T." (West Kirby)** *asks for a diagram of a circuit for a certain three-valve receiver.*

See diagram. (Fig. 3).

**"RECEIVER" (Beds.)** *refers to a certain set and asks* (1) *Whether it will give good results.* (2) *Why he gets "echoes" in receiving telephony.* (3) *Would Brown's A* 8,000 *ohm telephones be liable to be damaged in the* 30 *volt circuit of a plate.*

(1) This set should be capable of giving quite good results. (2) This effect is generally due to the reaction being adjusted too near the oscillation point. Try rearranging the reaction coupling. (3) Yes, frequently, but no definite programme is at present arranged. (4) No.

**"E.F." (Sussex)** *has constructed the school receiving set described in the October issue, and asks* (1) *Why the* 500 *turn coil used as A.T.I. gives no signals unless the hand is placed on the tuning condenser or the telephone terminals,* (2) *Would the addition of another valve enable him to hear Dutch Concerts.* (3) *For a diagram of a circuit using another valve.* (4) *How to prevent howling when listening to telephony.*

(1) Impossible to say without examination. It might possibly be due to a break in the coil, or a bad connection between it and the earth. (2) Yes, preferably as an H.F. amplifier. (3) See diagram (Fig. 4). (4) If the howls are due to your neighbour's radiating receiver you can do nothing If owing to your own set oscillating, weaken the reaction.

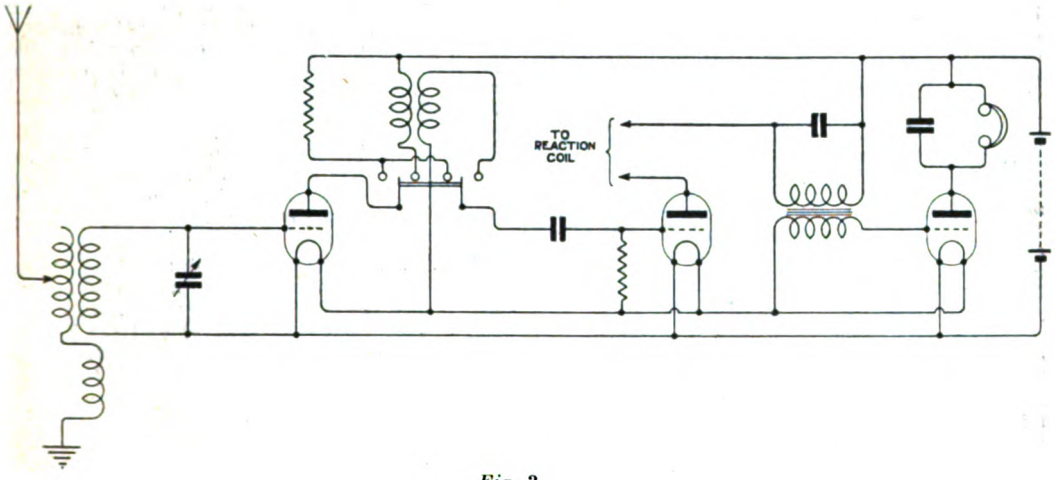


*Fig.* 3.

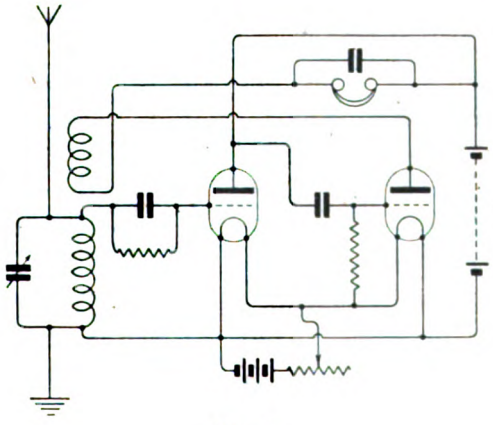

*Fig.* 4.

**"R.E.W." (Holyhead)** *asks with regard to the shunt control method for a radiophone transmitter* (1) *Is this system of radiophone transmission used successfully by amateurs.* (2) *In Mr. P. R. Coursey's article on this subject in the April issue,*



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*what should be the value of B.2 (Fig. 2) to give a total input of 10 watts, using R type valves with V.1 and V.2. (3) Can this circuit be used for C.W., if so, where should the key be connected. (4) Is it necessary to have L.3 and L.4 (Fig. 2) of heavy gauge wire.*

(1) The system is quite a good one. It has undoubtedly been used in certain forms by amateurs, but we do not know how far this particular modification has been applied. (2) You will not get a full 10 watts from 2 R valves efficiently. The 10 watts could be obtained by putting up the H.T. voltage, but the power radiated would not be increased. 150 volts will be as high as you can usefully apply. (3) Yes, insert the key in the grid circuit of the control valve, adjusting the static potential of the grid with a potentiometer until the best results are obtained. (4) The wire need not be of very heavy gauge for this power. Use, say, No. 18, or better, 7/24 or 7/26 stranded cable.

**"V.H.T." (Canterbury)** *asks (1) For criticism of enclosed diagram of circuit with possible improvements. (2) Why do single honeycomb coils made by different firms vary as to wavelength. (3) Which type of coil should be best, those covering the smaller wavelength or those covering the greater. (4) Could he receive* **PCGG, 2MT, LP, NSS** *and aircraft telephony with the set described.*

(1) The circuit is O.K., except that the reaction coil should be in series with the primary of the inter-valve transformer, and not in shunt across it. Also, the use of loose coupled circuits would minimise the danger of considerable re-radiation. (2) This may be due to the difference in the condensers (some have a much lower minimum capacity than others), or more probably to differences in the self-capacities of the coils. (3) The latter. (4) You should do if the inductances of the coils used are suitable.

**"G.A.H." (Farnborough)** *asks (1) The capacity of a certain variable air condenser. (2) What would be the capacity if the fixed vane spacing was ½" instead of 5/16". (3) What weight and gauge of wire is required for a 2" former for use as a telephone transformer.*

(1) Approximately 0·0002 mfd. (2) Approximately 0·00026 mfds. (3) 2" is too big a diameter for efficiency. Make the core ½" diameter, the windings may then be 6 ozs. No. 30 S.W.G., and 3 ozs. No. 44 S.W.G.

**"S.W.B." (Manchester)** *asks for advice with regard to certain troubles in his receiving set.*

We are afraid there is no certain cure for the induction troubles you complain of. It might help to abandon the use of grid condensers and leaks. Also put a condenser across the winding of the inter-valve transformer in series with the reaction. Try shielding the apparatus, particularly the iron cored transformers, in an iron, or iron-covered box. If possible get the aerial at right angles to the tram wires, or as far as possible from the telephone wires. Do not use a too critical reaction.

**"H.F.L." (Chesterfield)** *asks (1) the difference between high and low frequency transformers. (2) If a circuit sketched will receive* **PCGG**. *(3) Maximum and minimum wavelength of the circuit. (4) Windings for the coils.*

(1) H.F. transformers are in general air-cored and are designed to efficiently transform radio-frequency currents before rectification. L.F. transformers are iron-cored, and arranged to transform currents of auto-frequency. (2) No, not without additional amplification. Moreover, a grid leak is useless without a grid condenser, and L.R. telephones cannot be used in such a circuit without a transformer. (3) Impossible to say as no dimensions of coils are given. (4) 6"× 4" of No. 24 for the A.T.I., and 4"× 3" of No. 28 for the reaction coil will give a useful range.

**"L.U.C." (Brighton).**—(1) This condenser is useful for long wavelengths, but will not be necessary under about 1,000 metres. Capacity can be about 0·0005 mfds. Arrangements may be made to switch the series condenser over to this position if desired. (2) Telephones should be connected across the I.P. and O.P. terminals as shown in the diagram. (3) This tuner is unsuitable for alteration for so large a range. Dismantle and use the pieces for incorporation in a new set with honeycomb coils. (4) Current always flowing in one direction through a circuit. See any electrical textbook for the distinction between this and A.C.

**"E.W.S." (Hurstpierpoint)** *wishes to make up a panel receiver embodying a detector oscillator valve, and one note magnifier and tuning up to 4,000 metres, and asks (1), (2) and (3) Types of coils to adopt. (4) Whether the results that his present single-valve set gives are satisfactory. He receives* **2MT** *comfortably at Southend-on-Sea.*

(1), (2) and (3) For compactness and at the same time keeping self-capacity to a minimum, you would be well advised to make up coils of the style shown on page 328, June 10th issue. These can be mounted to take up very little space by making a ¼" hole through the centre of each card, and assembling them on an ebonite rod fixed to the under face of the panel, and putting a thick cardboard ring, 1½" in diameter, between each inductance card (4) Yes.

**"T.S.F." (Edinburgh)** *asks for a circuit for a four-valve set comprising 1 H.F., 1 rectifying and 2 L.F. valves, with switching arrangement for transferring telephone transformer primary from last valve to plate circuit of second valve, and at the same time switching off the filament current of the two L.F. valves.*

For circuit see reply given to **"DE RESKE" (Ashfield).**

**"J.G.W." (Loughborough)** *wishes to know (1) What posts are obtainable connected with wireless other than operating. (2) The qualifications necessary for such posts. (3) How to obtain such qualifications. (4) Probable pay.*

There are many posts, such as designer, research engineer, maintenance or installing engineer, wireless instrument maker, salesman, demonstrator, etc. (2) A thorough knowledge of all branches of modern wireless telegraphy, together with such specialised ability as the post may demand. (3) A sound grounding in electrical, physical and general scientific work, such as can be obtained at any of the recognised university centres, followed by experience in the class of employment selected. As with all other occupations a keen interest in this very specialised work is essential. (4) Varies according to ability, but equal to that in other branches of electrical engineering.

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**"K.C.L." (Bedford)** *asks* (1) *If crystal circuit which is that shown on page* 120, *April 22nd issue, but without potentiometer and with blocking condenser can be recommended.* (2) *Windings for coils to tune up to* 4,500 *metres.* (3) *Dimensions for making variable condenser with large test tube.* (4) *Whether it would be an advantage to use smaller tuning condensers but connected in parallel to make up the necessary total capacity.*

(1) Yes. (2) Aerial coil of loose coupler, 4" of winding on 4" former of No. 26 D.C.C. Loading coil 8" of winding on 4" former No. 26 D.C.C. Secondary 4" of winding, No. 28 D.C.C. with tappings according to your switches. (3) This method will not give sufficient capacity (0·0005 mfd.), but if you are particularly desirous of working somewhat to these lines see page 197, May 13th issue. You may increase the capacity by completely covering the outer face with foil, and arranging inner plate which extends round the wooden cylinder slide, instead of revolve. (4) Little would be gained.

**"H.E.P." (Birmingham).**—(1) The address of Messrs. Robert W. Paul is 69, Addison Road, W.14, and their works are at New Southgate, London, N. (2) Without a description of the set it is quite impossible to give you a diagram or (3) advise you on its capabilities.

**"T.H." (Marske-by-the-Sea)** *submits two circuit diagrams and wishes to know* (1) *If they are correct.* (2) *Which would give the better results.* (3) *Which would be the easier to construct and manipulate.*

In your circuit (1) you show both potentiometer and grid condenser, grid potential control, on the rectifier valve. Both are not necessary but, of course, would not be detrimental. As you tune the plate circuit with the intervalve oscillation transformer, in construction you might provide a varying coupling. It is not necessary to bridge the primaries of the second intervalve transformer and telephone transformer with condensers. Do not connect the aerial tuning condenser on the earth side of the aerial tuning inductance when in series, for if you do you will have the whole of your receiving apparatus insulated from earth and above earth potential. (2) Circuit No. 1, as rectification, must be arranged after high frequency amplification. (3) Very little to choose between with regard to construction, but the operation of reaction coil in the plate circuit of the second valve as in circuit 1 would be easier.

**"S.T." (Manchester)** *asks* (1) *For approximate windings for H.F. transformers for operating on wavelengths of* 600/10,000 *metres.* (2) *Dimensions of formers for these tranformers and sizes of wire.* (3) *Diagram for two-valve circuit for telephony, using transformer coupling and tunable to* 24,000 *metres.* (4) *Whether slab coils are suitable for telephony.*

(1) and (2) Use former of ebonite rod 1" in diameter, and wind with Nos. 28 to 42 S.S.C. wire. For wavelengths up to 300 metres use 150 turns for primary and the same number for the secondary, wound over one another and insulated with a single layer of empire cloth. For 600 metres use 600 turns each. For 1,200 metres use 1,500 turns each, or, as this will be rather long, 800 turns on a 2" ebonite tube may be used Beyond this wavelength use resistance capacity intervalve couplings. (3) For circuits see Fig. 1, page 235, May 20th issue; Fig. 2, page 213, May 13th issue, and read also article by H. G. Evans, M.Sc., page 133, April 29th issue. (4) Yes, and you would be well advised to construct them in the manner shown on page 328, June 10th issue.

**"GRID LEAK" (Glasgow)** *asks* (1) *How to convert "office" receivers into L.R. head telephones.* (2) *Windings for a suitable transformer for use in connection with these receivers.* (3) *Names of firms supplying wireless apparatus on a deferred payment system.* (4) *Capacity of a given condenser.*

(1) and (2) We do not understand what type of receivers you refer to, but if you mean receivers such as are used for land-line telephony, we do not think that these can be successfully rewound for wireless use. (3) We are not aware of any firm undertaking this class of business. (4) About 0·0002 mfd.

**"J.H.A." (Bedford)** *wishes to make a receiver for the reception of telephony, C.W. and spark signals up to* 3,500 *metres. He has aerial and a pair of telephones and proposes adopting the circuit shown on page* 100, *April 22nd issue, and does not want to spend more than* £6. *He asks for windings for inductances and values of condensers.*

The aerial tuning condenser should be of the air dielectric type, and have a maximum value of 0·001 mfds. This can be purchased from any of the dealers in surplus Government wireless apparatus, to whom you should apply for prices. The aerial inductances may consist of a total of 8" of winding of No. 28 D.C.C. on a 5" former, and the reaction coil 4" of winding on a 3½" former and sliding inside the aerial inductance. Both inductances tapped out. The aerial at about 20 points and the reaction circuit about 7. Special coils should be made for 400 metres telephony of the style shown on page 328, June 10th issue, using one in the aerial and one in the reaction circuit. The grid condenser should consist of three strips of metal foil, ¾" wide by 1¼" overlap, and separated with two of mica 0·002 in thickness. The leak should have a valve of about two megohms, and you are recommended to purchase one of reliable make. The intervalve transformer may also be purchased from dealers in ex-Government wireless apparatus, or made up as described on page 152, May 28th, 1921, issue. Condensers C2 and C3 should consist of 15 metal foils of above dimensions, separated with 16 micas.

**"N.H." (Shrewsbury)** *wishes to know* (1) *Power required to communicate over a distance of* 190 *miles, using P.M.G aerial and single valve receivers.* (2) *What valves to use in circuit diagram.* (3) *Dimensions of A.T.I. and A.T.C.* (4) *Whether he would be permitted to communicate over this distance.*

(1) With efficient apparatus 50 watt valve transmitters should be suitable for signalling over this distance (2) and (3) The "U" type, made by the General Electric Company, would be suitable, but write to the valve manufacturers stating your requirements. 240 volts is too low for the power stated in (1). For circuit diagrams and windings see pages 127 to 144, May 28th, 1921, issue, omitting, of course, microphone and modulating valves. (4) Depends upon circumstances, and judging from your letter we should think improbable but ask the Postmaster-General, giving him your reasons

**"H.W.W." (Walthamstow)**—Your circuit A is satisfactory, excepting that you have omitted



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a condenser 0·002 mfd across the telephone receivers, and also it is better to connect the aerial tuning condenser on the aerial side of the inductance than in the earth lead, so that the whole of the apparatus is not insulated from earth with its components all above earth potential. Your circuit B is not recommended, whilst circuit C is quite good, but try loose coupling in the aerial circuit.

**"W.G.M." (Bristol).**—(1) The circuit you submit is quite good, but you omit to show a condenser (0·002 mfd.) across the telephone receivers. For the construction of such a set see page 140, April 29th issue, and also watch the "Experimental Station Design" appearing in alternate issues. (2) Receiving range will depend upon efficiency of aerial and power of transmitting station, but as an example it should be capable of receiving the telephony transmitted by Writtle **(2 MT)** up to 50 miles. (3) and (4) Extra valves can be added in the many ways shown from time to time in this journal. See page 100, April 22nd issue.

**"S.A.R." (Croydon).**—(1) Your circuit Fig. 1 is quite correct, but without further practical details we cannot suggest cause of your trouble, as it must obviously lie in some constructional error. Your Fig. 2 is rather strange. For the reception of Croydon telephony transfer the variable condenser to the aerial circuit. No circuit termed "reaction" is required with a crystal receiver. (2) You can easily add H.F. valve and for circuit see Fig 8, page 217, May 13th issue, using common H.T. and L.T. batteries for the operation of both valves. (3) "Note magnifying" or "L.F valves" magnify after rectification of oscillations. "H.F." valves increase the amplitude of high frequency oscillations. (4) The basket coils you propose making are quite unsuitable for 400 metre reception. The aerial coil 1" inside diameter × 4" outside, wound with No. 36, would tune a P.M.G. aerial up to approximately 1,200 metres, and such fine wire is not recommended. Make up flat coils similar to those shown on pages 327 and 328 June 10th issue.

**"R.W.D." (Derby).**—(1) and (2) Your trouble in the reception of telephony, inasmuch as signals are strong but undecipherable, is probably due to difficulties in the manipulation of reaction.

**"E.W.M." (W.C.2)** *wishes to know with regard to a C.W. Mark III receiver.* (1) *Whether it will receive the Dutch Concert.* (2) *If it is a good set for telephony reception.* (3) *Whether the oscillations it is likely to set up will prove a nuisance to other amateurs in the neighbourhood, and if so how far will its effects be felt.* (4) *For suggestions for improvement.*

(1) Suitable, but the inductances may need to be rewound to suit the dimensions of your aerial. The Dutch Concert is difficult to receive compared with the British telephony transmission, particularly that occasionally transmitted by Marconi House **(2 LO)**. (2) Quite good. (3) Yes, in the immediate vicinity, say up to half a mile, and depending upon the degree of amplification used by the stations affected. It is a record that oscillating receiving sets using less than 70 volts H.T. have interferred with other stations 15 miles away. (4) For short wave work connect the aerial tuning condenser in series with the aerial tuning inductance.

**"T.R.S.S." (Perth)** *asks* (1) *Will the Paris time, English and Hague Concerts be heard distinctly at Perth with a Sullivan two-valve amplifying receiving panel.* (2) *Is a twin aerial earth wire 47' long and 2½' apart sufficient.*

(1) Paris time probably, but English and Dutch Concerts very doubtful. (2) Yes, if the aerial is well above the level of the roof. It is better to separate the wires more than 2½'.

**"S.W." (London)** *asks* (1) *If amateur receiving is allowed in Ulster.* (2) *Where to apply for the necessary licence.*

(1) and (2) Write to the Secretary, G.P.O., London and he will no doubt pass your letter to the administrative authority concerned.

**"DABBLER" (Partick)** *asks* (1) *The name and address of a firm which makes or sells the "Johnsen Rahbek" loud speaker.* (2) *Where it would be possible to obtain an agate cylinder.*

(1) To the best of our belief this instrument has never been made commercially, at all events in this country. (2) Any good firm of lapidaries would probably undertake grinding the agate cylinder for you or one of the firms advertising experimental work in the columns of this, or other scientific periodicals, would probably undertake the construction of the complete apparatus. A letter on the subject addressed to author of recent article, care of this Journal, would be forwarded and might bring you helpful information.

**"SPARKS" (Grimsby)** *asks with regard to a crystal set* (1) *What distance or wavelengths he will get.* (2) *Any suggested improvements.* (3) *What apparatus is required for a two-valve set capable of receiving Dutch Concerts.* (4) *Diagram of a two-valve set showing arrangement.*

(1) A properly arranged set would tune to about 2,000 metres, but would not be efficient above about 800 with so small a coil. (2) The suggested scheme is very poor. Try the circuit of Fig. 2, page 120, April 22nd issue. (3) Apparatus required :—

H.T. Battery.
L.T. Battery.
2 valves.
2 Valve holders.
1 Grid condenser and leak.
1 Filament resistance.
1 Anode resistance.
1 Reaction coil.
1 Blocking condenser.

(4) See diagram in Fig. 2, page 213, May 13th.

## SHARE MARKET REPORT

Prices as we go to press on June 30th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 6 | 9 |
| ,, Preference .. .. | 2 | 3 | 6 |
| ,, Inter. Marine.. .. | 1 | 10 | 0 |
| ,, Canadian .. .. | | 10 | 9 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 0 | 3 |
| Preference .. .. .. | | 14 | 6 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 16. JULY 15TH, 1922. WEEKLY

## A Four Valve Station Particularly Suitable for Short Wavelengths

By PERCY W. HARRIS.

IT is generally accepted that to obtain the highest efficiency of reception on all wavelengths from the very shortest in everyday use (about 180 metres) to the great wavelengths used for long distance communication, two distinct sets of apparatus should be used, one for the short waves and one for the longer. The several reasons for this have frequently been discussed in this magazine and have been pointed out in answers to correspondents. The growing use of short waves for amateur communication, and particularly the adoption of short waves for broadcasting, has drawn renewed attention to the subject, and the writer ventures to think that a description of a special short wave set which he has recently constructed may aid those amateurs whose attention so far has been concentrated on wavelengths above the 400 mark.

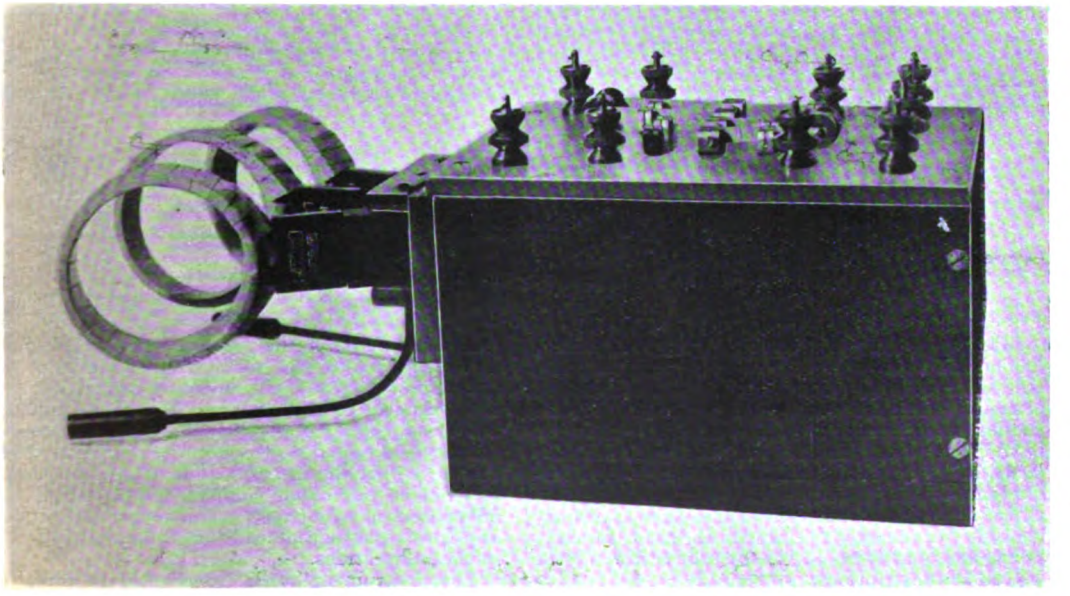

*Fig. 1. The Tuning Unit with three short-wave coils in place.*

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As a preliminary it should be stated that the efficient reception of short waves is by no means easy, and if efficient high frequency amplification is also desired it is hopeless to expect a set of the "one-control" variety. The apparatus to be described is therefore designed, not for the actual beginner, but for the serious experimenter who is prepared to take a little trouble in adjustment to obtain the best results. Incidentally the reception of long wavelengths has also been borne in mind, as well as the adaptability of the component parts to general reception work, and the construction is such that it can be attempted with a minimum of tools.

## THE TUNER.

Short wave reception can be carried out with the detector shunted across the aerial inductance, and not placed in a secondary circuit. In such cases a variable condenser may be connected either in series or parallel. In the first case there is loss of efficiency, and in the second very few turns, and therefore low potentials on the grid, are the inevitable consequence. For this reason, at least, it is advisable to place the detector in a secondary tuned circuit where a greater potential is obtainable, and a further advantage consists in the greater selectivity which results. A reaction coil is also desirable if the best is to be obtained from the valve.

Interchangable plug-in coils, of the honeycomb, duo-lateral and other types are very popular, but until recently have not been available in efficient forms for short-wave working. Within the last month or two a series of short-wave coils have been placed on the market by one of the firms in the trade, consisting of single-layer inductances wound on ebonite formers of about three inches in diameter. These are eminently suitable for short-wave work, the self capacity being low, and were chosen by the writer for the set under description.

Strangely enough, there appears to be no *tuner* on the market designed to take three coils. Several devices are given this name, but on examination they prove to be nothing but three-coil holders, without any means of changing from "stand-by" to "tune," or from "series" to "parallel" in the case of the aerial tuning condenser, other than by disconnecting the several leads and reconnecting them in the desired fashion. The writer therefore set to work to design and make a tuner to fill his requirements, detailed drawings and photographs being given here.

Bearing in mind that variable condensers are expensive, and that most workers use all they have for general experimental work, the variable condensers are not built into the tuner, but are connected to the necessary terminals. This has the further advantage that for very short wave work, small variables can be used, and for long wave working, condensers of larger value can be connected up. The general appearance of the finished instrument will be seen in the first photograph.

On the top of the panel, which is made of ¼-inch ebonite, there are ten terminals in all. Of the back row the two on the left are for aerial and earth respectively, and the pair on the right for reaction. The terminals for connecting the detector or first valve are on the right (middle), the two lower pairs being reserved for the primary and secondary condensers.

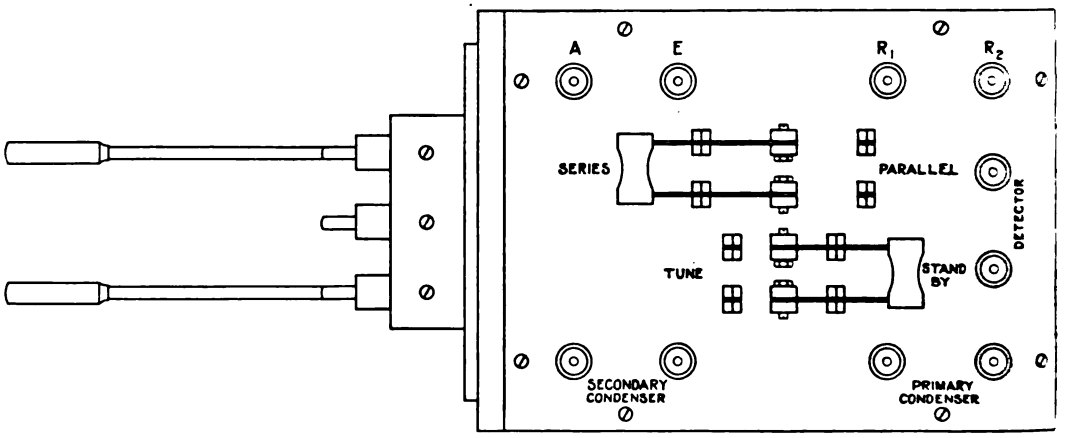


*Fig. 2. Arrangement of terminals and switches.*

In the middle of the panel are two double-pole, double-throw switches (taken from an old Mark III tuner, in this case), the upper of which changes the primary condenser from series to parallel, the lower changing the detector from across the primary inductance to across the secondary. On the left of the instrument is mounted a three-coil holder purchased complete from one of the advertisers in this paper. The actual connections are shown photographically and diagrammatically in the illustrations.

This instrument works excellently in practice. A further refinement might have been added by making the reaction connections reversible

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by a switch, but this would have added to the complications of the wiring, which is inadvisable in short-wave work. Further, it is necessary when working on "stand-bi" to swing the secondary coil well away from the primary, or some of the energy will be absorbed in the closed circuit. In the army tuners arrangements were made to disconnect one lead of the secondary circuit when

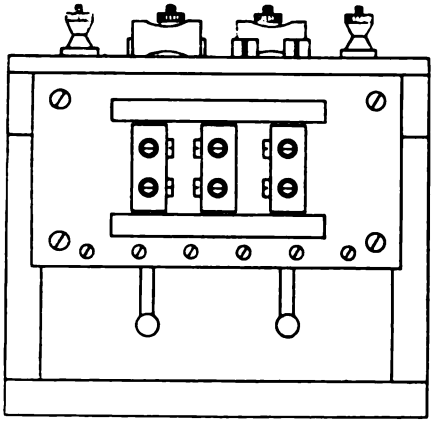

*Fig. 3. End view showing three-coil holder.*

working on the primary side, but in the set described this was not done—once more to avoid complications. If the secondary coil is swung back, no trouble will be experienced, while the wiring is much simpler.

Wiring is effected with No. 18 tinned copper, with the exception of the leads from the coil holder, which are No. 24. Connections are soldered throughout and sistoflex tubing fitted to each lead. The box measures five inches deep by six inches wide, this measurement being standard throughout the set. The tuner is eight inches long. The other units are longer.

In building up the set the box should be obtained or constructed first, the bottom being left unattached. Then obtain the sheet of ebonite and cut it to the exact measurements of the top of the box, and drill the necessary holes for switches and terminals. When these are fitted attach the three-coil holder to the side of the box, previously connecting long leads to each of its six terminals. These leads should be threaded through six holes in the box, the holes being made large so that subsequently insulating tubing can be slipped through in a way to be described. Quarter-inch holes will do for this purpose. In mounting the holder, see that none of its terminals touch the wood of the box, or there may be leakage.

All connections, save those to the three-coil holder, can be made on the panel before it is fitted to the box. When this is done attach the panel with eight wood screws in counter-sunk holes, as shown, and invert the whole box.

Take each of the leads from the three-coil holder, stretch it across to its correct terminal and cut off just enough wire to reach. Then cut a length of insulating tubing about a quarter of an inch less than the length of the lead, and slip it over the wire, forcing it through the hole in the box right up to the terminal of the coil holder outside. This will effectively insulate the wire from the box. The tip of the terminal should have been "tinned" previously, and if a well-heated soldering bolt is used, each lead can be neatly joined without difficulty to its proper terminal.

A tuner constructed in this way will be found to be equally efficient on long and short waves, if for the latter single-layer coils are used. Such coils are easy to construct, and can be wound on ebonite tube of three inches or more in diameter, subsequently being fixed to the well-known plug mountings. As, however, a set of four such coils can be bought for about 25s., they are scarcely worth the trouble of making, taking into account that the plugs must be purchased in any case. For long waves any of the well-known multi-layer

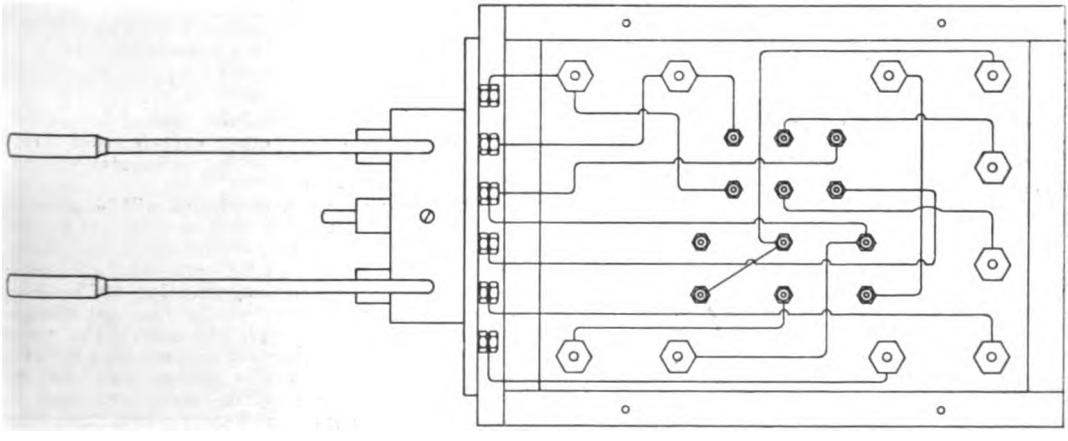

*Fig. 4. Under side of panel to show wiring.*

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coils will suit, as the plug fittings are now standardised.

For short wave working a pair of 0·0005 mfd. variable condensers will serve quite well, although on "concert" wavelengths a 0·001 mfd. is not too large to handle when practice has been obtained. Those who have them can use vernier condensers in addition. The best reaction coil for the particular wavelength will be found by trial, but usually one number above or below that used for the detector circuit will be found about right. Thus a "50" coil will work well with a "75" for reaction, or a No. 4 short-wave coil with a No. 3.

It will be noticed that the reaction coil is arranged to act on the aerial circuit. It would be difficult to arrange otherwise, for it must act on the aerial circuit when "stand-bi" is used, and to act on the secondary on "tune" adjustment would need an elaborate change-over switch which would again complicate the device. The writer always uses a separate heterodyne for C.W. reception, so that this reaction on the aerial does not cause radiation in his case. If, however, the user wishes the reaction to act on a loosely coupled secondary, it is only necessary to place the switch on "stand-bi," the condenser switch on parallel, connect the aerial and earth to the secondary condenser terminals, and leave the other connections as they are. If the aerial condenser is needed in series and not in parallel, the condenser which is normally the secondary should be placed in series with the aerial wire, the switch on the tuner being still left at parallel, as this is, at the moment, controlling the secondary circuit. The fact that all leads are brought out to terminals makes it possible to use this tuner for other experimental work, such as using the third coil for variometer working with one of the others.

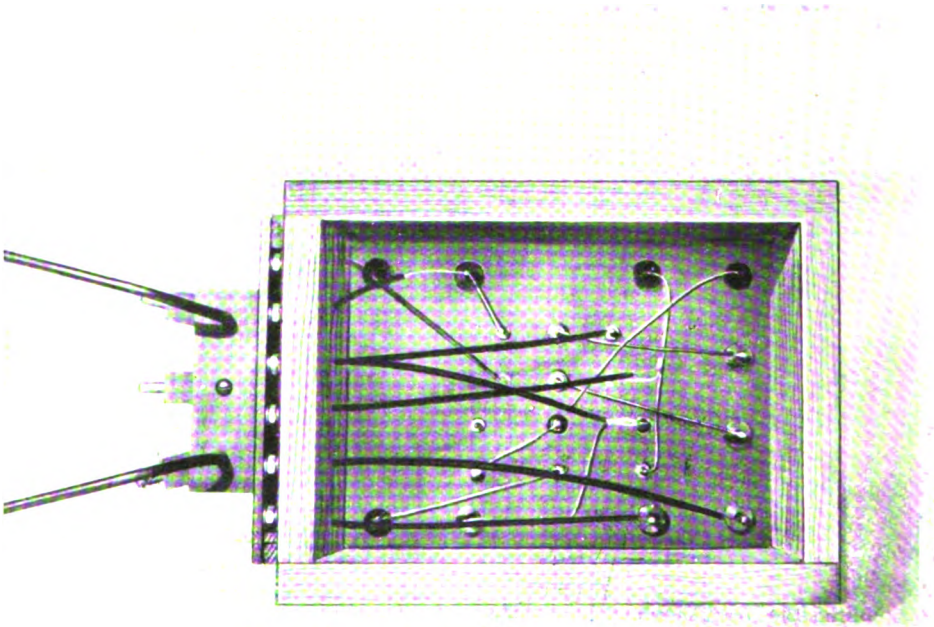

*Fig. 5. A photograph of the under side of the tuner, with bottom of box removed.*

In the next article a description will be given of a two-valve short-wave receiver (one H.F. and detector). This will be followed by a description of a two-valve note magnifier with switch to enable one or two stages of magnification to be used at will, the whole set, with the tuner, forming a four-valve station of high efficiency. The tuner and the two-note magnifying unit are both suitable for long-wave work, and a method will later be described for converting the short-wave unit to long-wave working at a moment's notice. Questions on this set will willingly be answered through the columns of the magazine.

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# Time Signals

## HOW CLOCKS ARE CHECKED WITH SCIENTIFIC PRECISION.

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

### (1) Historical.

AS the practical outcome of efforts made by the *Bureau des Longitudes*, a time-signal service was established in 1909. Signals were first transmitted twice daily by the radio-telegraphic station at the Eiffel Tower and were primarily intended for navigation purposes. Shortly afterwards, the German wireless station at Nordeich established a time service, using a different code from that used in the Eiffel Tower transmissions. The practical value of these two services having been demonstrated and their usefulness to navigation and other purposes having been proved, a conference was called in 1912 to consider the whole question upon a world basis and to devise an International Code for transmission. Accordingly, a new system was drawn up and was first employed on 1st July, 1913, by the Eiffel Tower. This system is still used by this station at 0923 every day and by nine other stations in different parts of the world. The original system, generally known as the French system, is, however, still used by FL at 1044 and 2244. At the present time there are 45 stations which send out T.S. regularly. Unfortunately there has been but little co-operation among the various countries in the use of a standard code, with the result that these 45 stations use no less than 15 different codes between them.

A list of stations and their transmissions is given in the table below in connection with which the following points should be noted:—

i. Times of sending are given in G.M.T., civil reckoning (*i.e.*, 0000 corresponds to midnight, 1200 midday, the third and fourth figures signifying minutes past the hour).

ii. In most cases the Greenwich mean times are adhered to both in summer and winter.

## TABLE

### COMPLETE LIST OF STATIONS TRANSMITTING TIME SIGNALS

| Country. | Station. | Call. | Wave-length. | G.M.T. Times. | Notes. |
|---|---|---|---|---|---|
| Australia .. .. | Adelaide .. .. | **VIA** | 2,600 | 0227–0230<br>1427–1430 | International. |
| ,, .. .. | Melbourne .. .. | **VIM** | 600 | 0157–0200<br>1357–1400 | ,, |
| ,, .. .. | Perth .. .. | **VIP** | 600 | 2257–2300<br>1057–1100 | ,, |
| ,, .. .. | Sydney .. .. | **VIS** | 600 | 2257–2300<br>1057–1100 | ,, |
| New Zealand .. | Wellington .. .. | **VCW** | 600 | 0859–0905 | Automatic; dashes begin at 0900 1–2–4–5. |
| South Africa .. | Capetown .. .. | **VNC** | 600 | 2059–2100 | Special Code. |
| Portuguese S. Africa | Lourenço Marques .. | **CRZ** | 600 | 0757–0800<br>1857–1900 | International. |
| Canada .. .. | Camperdown .. | **VCS** | 600 | 1358–1400 | Special code. |
| U.S.A. .. .. | Annapolis .. .. | **NSS** | 17,000 arc | 0255–0300<br>1655–1700 | American system; daily. |
| .. .. .. | Eureka .. .. | **NPW** | 2,000 | 1955–2000 | ,, ,, ,, |
| .. .. .. | Great Lakes .. | **NAJ** | 1,512 | 1655–1700 | ,, ,, ,,* |
| .. .. .. | Key West .. .. | **NAR** | 1,500 | 0255–0300<br>1655–1700 | ,, ,, ,, |
| .. .. .. | New Orleans .. | **NAT** | 1,000 | 1655–1700 | ,, ,, ,, |
| .. .. .. | North Head .. .. | **NPE** | 2,800 | 1955–2000 | ,, ,, ,, |
| .. .. .. | Point Arguello .. | **NPK** | 1,512 | 1955–2000 | ,, ,, ,,* |
| .. .. .. | San Diego .. .. | **NPL** | 2,400<br>9,800 | 1955–2000 | ,, ,, ,,* |
| .. .. .. | San Francisco .. | **NPG** | 2,400 spk.<br>4,800 arc | 1955–2000<br>0555–0600 | ,, ,, ,,<br>,, ,, ,, |
| .. .. .. | Washington .. .. | **NAA** | 2,500 spk. | 0255–0300<br>1655–1700 | ,, ,, ,, |
| Panama .. .. | Balboa .. .. | **NBA** | 7,000 arc. | 1755–1800<br>0955–1000 | ,, ,, ,, |
| .. .. .. | Colon .. .. | **NAX** | 1,500 spk. | 1755–1800<br>0955–1000 | ,, ,, ,, |

* Except Sundays and holidays.

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| Country. | Station. | Call. | Wave-length. | G.M.T. Times. | Notes. |
|---|---|---|---|---|---|
| Panama .. .. | Darien .. .. | **NBA** | 10,110 | 1755–1800<br>0955–1000 | Operated under distant control from Balboa. |
| Hawaii .. .. | Pearl Harbour .. | **NPM** | 600 damped<br>11,200 undamped | 2355–2400 | American system. |
| Brazil .. .. | Rio de Janeiro .. (Ilha de Governador) | **SOH** | 1,800 | 1355–1400<br>2355–2400 | International.<br>(Signals sent 30 minutes later in case of accident preventing transmission at correct time.) |
| Argentine .. | Buenos Ayres .. | **LIA** | 800 | 0155–0200 | Dots (duration ½ sec.) at end of each minute Daily, except Sundays and holidays. |
| Chili .. .. | Valparaiso .. .. | **CCE** | 600 | 1255–1300 | Dots every sec., except 29 and 51–58 inclusive, daily, except Saturdays, Sundays and holidays. |
| India .. .. | Bombay .. .. | **VWB** | 2,000 | 0057–0100<br>1257–1300 | International. |
| ,, .. .. | Calcutta .. .. | **VWC** | 2,000 | 0127–0130<br>1327–1330 | ,, |
| Dutch E. Indies.. | Soerabaya (Java) .. | **PKH** | 600 | 0209–0214 | Dots at 0210–12–14. |
| ,, .. | Weltevreden (near Batavia). | **PKB** | 600 | 0059–0104 | Dots at 0100–1–2–3–4. |
| Borneo .. .. | Kucking (Sarawak).. | **VQF** | 600 | 0039 | Special code. |
| Philippines .. | Cavite .. .. | **NPO** | 952 spk.<br>5,000 arc. | 0255–0300<br>1355–1400 | Dots every sec., except 28, 29 and 54-59 inclusive of each min., daily. |
| China .. .. | Hongkong .. .. | **BXY** | 2,000 | 0156–0200<br>1256–1300 | Dots of about 0·2 sec. duration at even secs.; 2, 28, 50, 52, 54 secs. omitted. |
| ,, .. .. | Shanghai .. .. | **FFZ** | 600 | 0253–0259<br>0853–0859 | Dots at 55, 57, 59 mins. past hour. |
| Indo-China .. | Kien-An .. .. | **FKA** | 600 | — | Special code. |
| Japan .. .. | Funabashi .. .. | **JJC** | 4,000 | 1159–1204 | Dashes begin at 59·00 01–02 03 04. |
| ,, .. .. | Choshi .. .. | **JCS** | 600 | 1159–1204 | ,, ,, ,, |
| Germany .. | Nauen .. .. | **POZ** | 3,100 | 1157–1200<br>2357–2400 | International. |
| France .. .. | Eiffel Tower .. | **FL** | 2,600 spk. | — | Times and codes given in previous article. |
| ,, .. .. | Lyons .. .. | **YN** | 15,500 | 0850 | Rythmic signals. |
| ,, .. .. | ,, .. .. | **YN** | 15,500 | 0859–0904 | Time signals. French system. |
| ,, .. .. | Bordeaux .. .. | **LY** | 23,450 | 1950 | Rythmic signals. |
| Indian Ocean .. | Mauritius .. .. | **BZG** | 2,000 | 0859–0901<br>2059–2101 | Dash operated from ob. at 0901 and 2101. |
| Mexico .. .. | Chapultepec .. | **XDA** | 2,000 | — | Special code. |
| Java .. .. | Malabang .. .. | **PKX** | 8,800 | 0057–0100 | ,, ,, |
| Russia .. .. | Petrograd .. .. | **TSR** | — | 1900–1905 | Dots at –03 04–05. |
| ,, .. .. | ,, .. .. | **TSR** | - | 1906–1914 | Rythmic signals. |
| ,, .. .. | Moscow .. .. | **MSK** | - - | 2155–2200 | Dots at –58–59–00. |
| ,, .. .. | ,, .. .. | **MSK** | — | 2202 | Rythmic signals. |

## (2) The Reception of Wireless Time Signals.

The present time services are of two different types :—

i. Ordinary time signals transmitted either automatically or semi-automatically.

ii. Rythmic-scientific signals which are entirely automatic.

Ordinary time signals such as those sent out by **FL** (see Fig. 3, p. 429*) give G.M.T. with an accuracy of ¼ second for a practised observer, but under the most favourable conditions and by employing a self-registering system of reception, a

* *Wireless World and Radio Review*, 1st July, 1922.

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maximum accuracy of 1/100th second is attainable. As previously mentioned, these signals are intended to enable navigators to set their chronometers while at sea at least once a day to standard G.M.T. (or prime meridian time), thus either entirely eliminating errors of rate in the chronometers or longitude measured from Greenwich. In effect the reception of accurately transmitted time signals is equivalent to establishing a transit circle on board ship. Consequently these signals are of great value when approaching shore or in danger of ice, while they are of sufficient accuracy for most of the

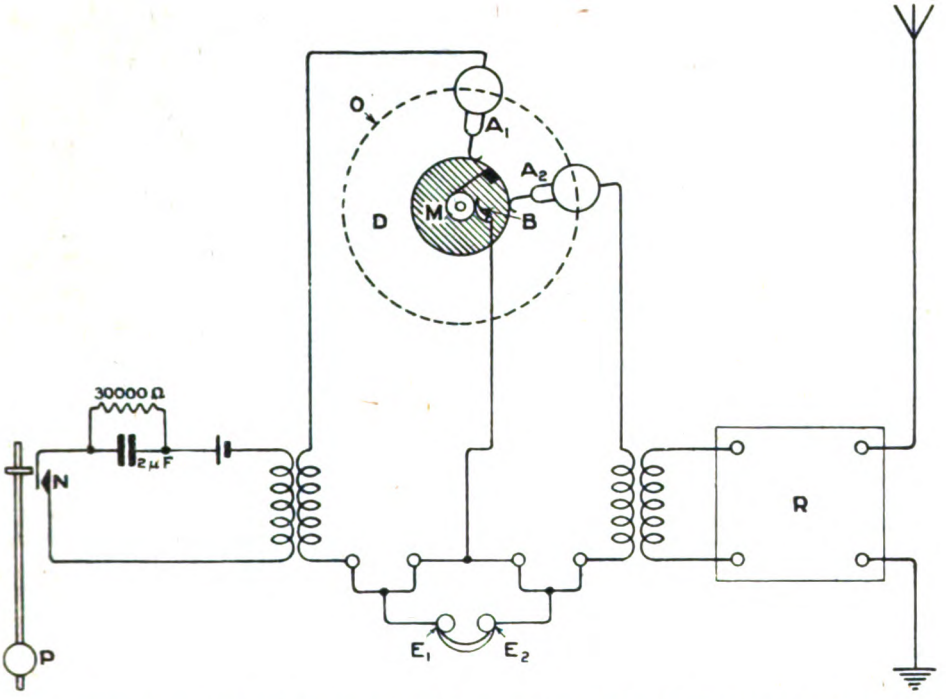


*Fig. 1. Apparatus used in the comparison of American Time Signals with the beats of a local clock for the purposes of the determination of longitude By this method, an accuracy of about 1/100 sec. is obtainable.*

reducing such errors to a minimum. If in addition the local mean time of the ship is determined by observing the sun or one of the other celestial bodies, and the observations are timed by the chronometer, the difference between the Greenwich and local mean times will be found and this is the ship's ordinary time-keeping purposes of every-day life, such as regulating town and railway clocks.

We shall now indicate a method of recording time *as accurately as possible* without the use of any self-registering system. Essentially, the problem is to compare the beats of a local pendulum with

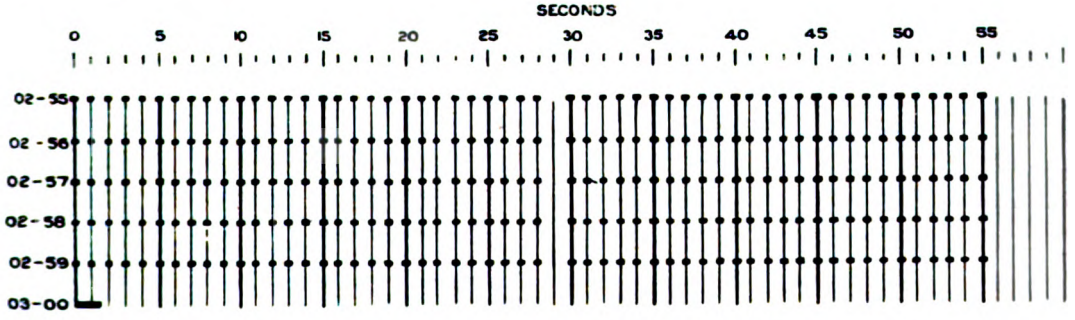


*Fig. 2. American Time Signal System.*



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the transmitted T.S., *both* of which must be conveyed to the telephones for aural comparison if anything but the coarsest approximation to the real time is desired. In this connection it may be pointed out that the eye is far less accurate than the ear, and no reliance can be placed on the movements of a seconds-hand between consecutive intervals of one second on the dial of a clock. For conveying the local time to the telephones either a microphone may be suitably placed within the clock chamber or direct contact may be established with the pendulum at successive beats as indicated in the system described (see Fig. 1, circuit $PNE_1$). For convenience, let us imagine that the observer is receiving ordinary T.S. from FL (French system, see Fig. 3, page 429*). In this system the dots at 1045, 1047, 1049 are automatically transmitted by the closing of a pendulum circuit of a clock in the Paris Observatory, all the other signals being sent by hand. These dots are of duration ½ second and are the only signals upon which reliance is to be placed. The observer has to place the position of the dots with respect to the beats of his own time apparatus. The actual reception may be represented more clearly graphically and the observer should proceed as follows :—

In the first place prepare a scale as shown in Fig. 3, the equidistant divisions in the scale marked 1-30 representing the beats of the local pendulum. Next note time of clock at beat 60 = 10h. 45m. Mark off beats as ticked out by the pendulum on the scale, and shown in the figure as dotted lines. By allowing the eye to travel along the scale at a uniform rate, place the ½ second T.S. dot as accurately as possible between the one second intervals of the pendulum. A practised observer should be able to do this to within a ½ second.

Calculation : T.S. = 10h. 45m.

Pendulum = 10h. 45m. 10·5s.

Correction = T.S. − (pendulum) = (10h. 45m.) − (10h. 45m. 10·5s.).

= − 10·5s.

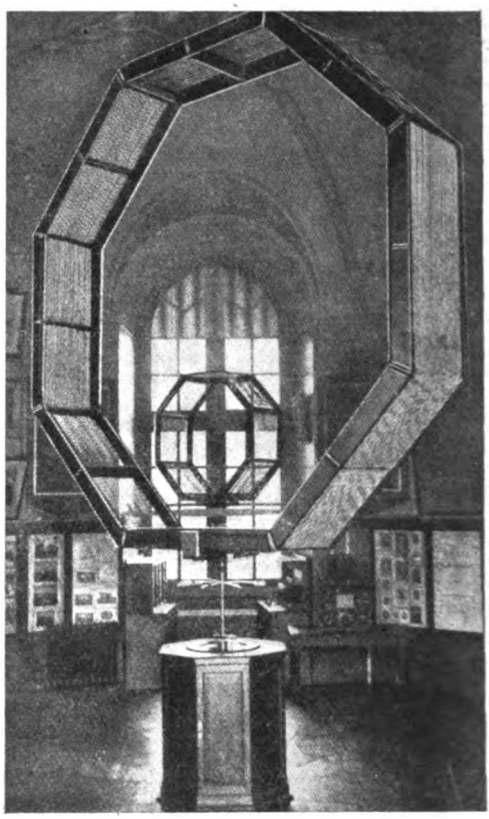
∴ Local clock is 10·5s. fast.

The following conditions are necessary for the highest accuracy :—

i. It is essential that the room where observations are made should be quiet and the observer free from disturbance so that his whole attention can be concentrated upon counting the beats of his local pendulum and placing the T.S.

ii. The preliminary signals enable him to tune in his T.S. circuit or adjust his local pendulum circuit until the ticks of the pendulum are just slightly louder than the T.S.

Continuing in the same manner with the 1047, 1049 signals the final result should be the arithmetic mean of the three.



*Installation at the Paris Observatory for the comparison of Time Signals received from Eiffel Tower, Lyons, Bordeaux, Annapolis, Nauen and other stations with the pendulum of the Observatory clock. Signals received on the frame aerial shown in the photograph are thus compared by aural methods and by self-registering apparatus shown near the window.*

ii. Rythmic signals are sent out regularly by Paris, Lyons and Bordeaux and consist of a series of 300 dots, each formed of a single spark, the 60th, 120th, 180th and 240th dot being suppressed in order to establish the indication for counting purposes. They are automatically transmitted by a pendulum so adjusted that it beats 49·50 second intervals. When brought together for comparison with a local time apparatus using the aural method, they serve the purpose of a time vernier, a

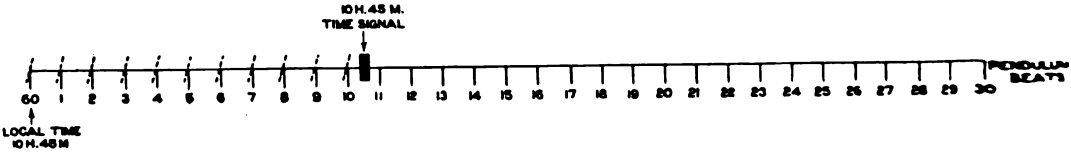



*Fig.* 3.

* *Wireless World and Radio Review*, 1st July, 1922.

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reading being made on beats which are coincident (or as nearly so as possible) in the two circuits. This series is heard at the Paris Observatory and compared by the same coincidence method with the tickings of the Observatory clock.

The exact tunes of the 1st and 300th beats are calculated at the Observatory to the 1/100th second and are sent out in the form of a group of 8 figures by FL at 1038 and 2236. The first two figures give the sidereal hour, the 3rd and 4th figures the minutes, 5th and 6th seconds, and the last two figures the hundredths of a second, all in sidereal time. The accuracy of the method depends upon the spacing and the number of the coincidences. The limit of accuracy is reached where it becomes difficult to judge the coincidences. With the present system (*i.e.*, dots spaced 49/50 sidereal second) an accuracy of 1/100th second is attainable, and with self-registering apparatus 1/1,000th second.

These signals are of great importance in the determination of longitude. Before the introduction of W/T, longitude determinations have been made by observing the transit of a star across the meridian at one observatory and automatically transmitting this instant by land-land to another observatory, the differences in the times of transit being compared. Experiments have also been made of the degree of accuracy obtainable by carrying chronometers by aeroplane between two different observatories whose difference in longitude is required. Neither method approaches the degree of accuracy obtained by the method of vernier beats.

Fig. 2 shows the code used by American stations. For comparing these dots with a local pendulum beating seconds, the coincidence method is unsatisfactory, but by employing other means a precision of the order of 1/100th second is attainable for longitude determinations. In these cases the following apparatus may be employed. An electrically driven motor is regulated so that its speed is constant as far as possible. The axle of the motor carries a disc M (see Fig. 1) of insulating material, which completes a revolution in one second. The edge of the metallic sector S is 1/100th of the circumference of the disc M. Brush contacts A and B complete the local pendulum circuit $PNE_1$ through S, while $A_2$ B complete the T.S. circuit R $A_2$ B $E_2$. $A_1$ and $A_2$ are movable contacts. The observer listens simultaneously in the telephone ear-piece $E_1$ to the series of beats produced by the making and breaking of the arm of the motor and the movable contact A, as well as to the series of beats of the pendulum. Thus by altering the position of $A_1$, the beats of the two series may be exactly superimposed so that they appear as one to the listener. Similarly, by altering the position of $A_2$, the two series (local pendulum and T.S.) may be superimposed. The angular separation of $A_1$ and $A_2$ then gives the interval separating the two series of signals.

# Welcome News Regarding Patents

## THE ATTITUDE OF MARCONI'S WIRELESS TELEGRAPH CO., LTD., TOWARDS THE ACTIVITIES OF AMATEURS

As a result of recent actions brought by Marconi's Wireless Telegraph Company, Ltd., against certain manufacturers for infringements of patents owned by that Company, there exists considerable uncertainty amongst amateurs as to their position in relation to the patent situation.

This is made apparent by the numerous letters on the subject received by *The Wireless World and Radio Review*, and in the interests of all wireless amateurs we referred the question to the Marconi Company in an interview.

We found the attitude of that Company towards amateurs to be very encouraging, and we have been authorised to make the following announcement, which should remove completely the uncertainty to which we have referred above.

Far from wishing to take advantage of its patent rights to hamper and discourage amateurs, the Marconi Company expresses its desire to assist rather than hinder them in following their hobby.

The Company has no intention of taking any action against amateurs who construct for their own use wireless apparatus embodying any of the patents owned by the Marconi Company, provided that such apparatus is not offered for sale, and is used only for amateur purposes. In this particular connection "construct" is intended to signify the actual manufacture, wholly or in part, of a wireless set, and not the mere connecting up of purchased instruments.

On the other hand the Company intends to protect its rights when unauthorised use is made of its patents in the manufacture of apparatus for sale publicly or privately.

Any patent action the Company has taken hitherto has been confined to the protection of its rights in respect of apparatus manufactured for sale by firms or individuals in infringement of the Company's patents with the object of commercial profit.

We feel sure that this announcement, which is endorsed by the Marconi Company, will give full satisfaction to all amateurs, and we appreciate the opportunity which has been afforded us to be the means of conveying to our readers such a reassuring statement. The many amateurs and clubs who have received demonstrations, lectures, special transmitting programmes and loans of apparatus and lantern slides at the hands of the Company know its encouragement of amateur wireless is practical and by no means a new policy.



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# The French Experimental Station 8 AB.

*Most British amateurs are now familiar with the capabilities of the French amateur station* **8 AB**, *and it will therefore interest our readers to have the following account, which has appeared in "L'Onde Electrique," from Mr. Léon Deloy, the constructor, describing the considerable experimental work done in the development of the station. The constructor wishes to point out that the station must not be taken as anything like a model example, as it has been put together with a minimum of time and apparatus.*

UNDOUBTEDLY there are numerous details which still remain to be improved and a more carefully planned installation would undoubtedly give better results. The principal ideas which have directed the installation have been to obtain in the minimum of time and with the minimum of material the best results possible. As these are the conditions which control the work of the majority of amateurs, and considering that signals have been heard as far as Aberdeen, Scotland, and within a radius of about 1,700 kilometres, we have reason to believe that the following description of the progress of the installation of **8 AB** may be helpful to many amateurs who contemplate the installation of C.W. transmitters, and perhaps these notes may be the means of saving them some loss of time.

The aerial which has been used in all our transmission experiments is an umbrella aerial consisting of three bronze wires of two millimetres diameter and 25 metres of effective length. They are extended by insulated cables and suspended from their point of connection by an ebonite insulator attached to the lightning conductor of the house where the station is situated. The mean height of this aerial from the ground is about 20 metres. The lead-in wire, which is taken from the top of the aerial, is about 10 metres long to the point where it reaches the instruments; this is also a bronze wire two millimetres in diameter. (*One must mention here that this aerial was constructed entirely for reception, and is far from ideal from the point of view of transmission, and its resistance in all probability would be largely diminished by replacing the single wires with stranded.*)

As soon as the necessary authority had been received for conducting experiments in transmission, we installed a valve station on the 24th November, 1921. The connections were those shown in the circuit diagram given in Fig. 1. The valve was an ordinary receiving valve type T.M. Alternating current was used for the filament, using a small tapped Ferrix transformer to step down the voltage.

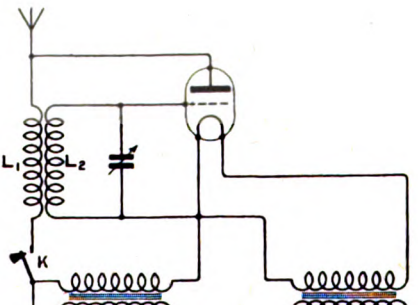


*Fig. 1. Connections of the first transmitter used.*

*Fig. 2. Mr. Léon Deloy photographed with Mr. W. J. Crampton whilst the latter was at Nice.*

The coils used for the primary and secondary were coils which had served in the construction of a heterodyne. They consisted of 300 turns of No. 24 wire for the anode and aerial coil wound on a cardboard cylinder 15 centimetres in diameter, and for the grid coil 250 turns wound on a cylinder 12 centimetres in diameter. The condenser of the grid coil was an ordinary receiving condenser of a capacity of 0·00075 microfarad. The plate voltage was supplied by a Ferrix transformer giving 250 volts at the secondary. Listening-in with a separate receiver and varying the positions of the inductances with respect to one another one could check the intensity of reception and so obtain the best adjustments for transmission.

This station was soon improved in the following manner. The key, instead of being placed in the

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earth lead, was placed in the primary of the high tension transformer. In this way it was possible to avoid the shocks which might be obtained if two ends of the key were touched at the same time. The second improvement consisted in employing two valves in parallel in place of one, and the signals of the station were at once heard at Cros-de-Cagnes at a distance of about 11 kilometres. A high tension transformer was next installed which gave 500 volts at the secondary in place of 250. In these circumstances the plates of the valves heated quickly, but for telegraphic transmissions, where the signals are never of long duration, this did not constitute a serious difficulty. The valve filaments were supplied with 5 volts in order to obtain sufficient electronic emission, but it is obvious that this excess voltage was detrimental to the life of the filaments.

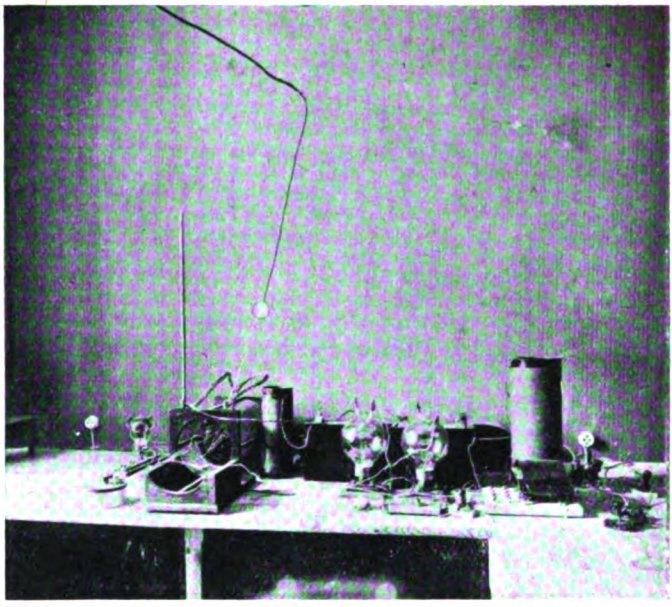

*Fig* 3. *The Experimental Set of* **8 AB.**

With this circuit completed, a 4-volt lamp with a carbon filament was put in series with the earth lead, in order to indicate by its brilliance approximately the best adjustment of the apparatus and to facilitate these adjustments. With this addition the station was rendered more powerful by employing four valves in place of two. The energy transferred to the aerial was then found to have been greatly augmented. Our signals were heard on the 24th of December, 1921, at Antives, a distance of about 18 kilometres. Up to this stage the earth connection had been simply to the water-pipe and now, with the assistance given by the lamp in the earth lead, we were able to ascertain that by connecting the earth lead in turn to water, gas and central heating connections, and to the lightning conductor, we increased the energy transferred to the aerial. Our first transmission had been made on a wavelength of 1,580 metres. Towards the end of December we came down to 960, then 725, and finally 525, employing other coils in the oscillating circuit. For 525 metres the same coils were employed which had been used for a long while in the receiving apparatus. The plate and aerial coil consisted of 120 turns of bell wire coiled on a cardboard cylinder 75 millimetres in diameter and the grid coil 100 turns of No. 24 wire coiled on a cardboard cylinder 55 millimetres in diameter.

At this stage the four receiving valves were replaced by two 50-watt transmitting valves, the connections being modified in the following manner. The transformer of 500 volts was replaced by a transformer of 1,000 to 2,000 volts. A fixed condenser was put in the plate circuit to allow the passage of H.F. currents, whilst a choke coil

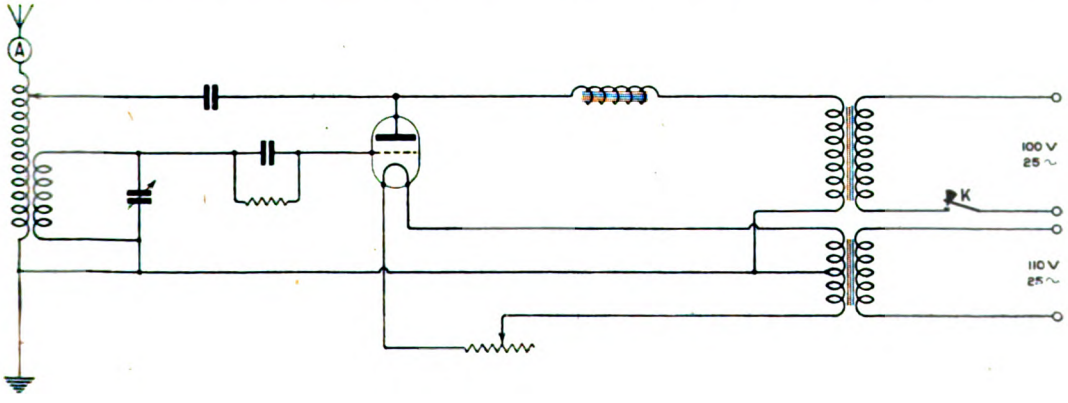


*Fig.* 4. *The final circuit used.*

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inserted between the secondary of the high tension transformer and the plates prevented the transfer of high frequency currents into the secondary. A grid condenser shunted by a resistance was also inserted as shown in Fig. 4.

By earthing a receiving aerial which hitherto we had left insulated during transmission, a considerable increase in aerial current was obtained.

The aerial coil and the grid coil were later replaced by an oscillation transformer constructed in the following manner. The exterior coil was formed of a copper tube 7 millimetres in diameter, wound in a spiral of 20 centimetres diameter, and consisting of about 30 turns spaced 7 millimetres apart. With this coil two metallic clips were used which permitted connection to be made to the aerial and plate wherever desired. The grid coil was constructed of bronze wire three millimetres in diameter, and consisted of 25 turns on a diameter of 17 centimetres, a metallic clip allowing the required number of turns to be included in the circuit. An aerial ammeter was included and thereafter all adjustments were made following its indications and with the successive improvements which we have just described, the aerial current gradually rose from tenths of an ampere to three amperes.

On the 23rd of March, 1922, when the aerial current registered 2½ amperes, our signals were heard at Bonifacio about 300 kilometres distant.

The replacement of all the earth leads which went from the apparatus to water, gas and other connections, by strip, and the elimination of all unnecessary joints in the high frequency circuit, enabled an increase of aerial ampereage from 3 to 4 amperes to be obtained. At the same time the wavelength was reduced to 360 metres in order to get away from interference caused by numerous stations working on 600 metres spark.

On the 1st of April, with 4 amperes in the aerial, our signals were received at Amiens, about 800 kilometres distant. At this time the two 50-watt valves were replaced by one 250-watt valve, the aerial current remaining at 4 amperes, but the valve was much less forced. At this stage we undertook tests with the experimental station of Mr. Burnham, **2 FQ**, at London. Mr. Burnham was putting 2½ amperes into his aerial, and we had every hopes of receiving him. Actually, after some days unsuccessful efforts, his signals were received very strongly by us on the 5th of April, at 2046 hours G.M.T. As to our own signals they had been received since the 4th of April by another London amateur, at a distance of about 1,100 kilometres. On the 7th of April, **2 FQ** heard us and we were able to communicate very easily backwards and forwards several times in the evening as well as on subsequent evenings.

*Fig. 5. View from the site of French* **8 AB.**

We have since learnt that we were received on the 8th of April by an amateur in Aberdeen, Scotland, at a distance of 1,700 kilometres. We have communicated with **2 OM**, another amateur station in London, and on the 16th of April received excellent signals from **2 CV**.

The arrangement of the circuit which we are at present using is shown in Fig. 4 with the only difference that we now use two 250-watt valves in parallel and the antenna current is normally from 4 to 5 amperes.

For the information of amateurs who may care

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to construct a similar station, the following dimensions of the principal pieces of apparatus which we have not already described above are given :— The plate condenser is composed of 40 photographic plates 18 × 24 centimetres to separate the foils.

The grid condenser is composed of 10 glass plates of 5 × 18 centimetres separating sheets of tinfoil. The grid resistance is of a special type not yet patented. The choke coil is composed of 250 turns of No. 24 wire on a cardboard cylinder 12 centimetres in diameter.

In concluding the description of this station which has effected the first communication by wireless between English and French amateurs, we wish to express our thanks on the one hand to the French Administration of Posts, Telegraphs and Telephones for having rendered it possible for amateurs to conduct such interesting experiments through having given authority for amateur transmissions, and on the other hand to French and English amateurs who have been good enough to notify us of the reception of our signals.

We express our most sincere wishes that the severe restrictions which at present hamper the work of our friends across the Channel will soon disappear, and that the future will realise numerous and regular communications between French and English amateurs. **8 AB.**

# Some Notes on the Construction of Small Shunt Switchboards

By MARCUS J. MARTIN.

THE shunt switchboard is a piece of apparatus little known or used by the amateur, although it is employed largely by electricians for purposes where a number of various pieces of apparatus are used, each working at a different voltage and taking different amounts of current.

To the wireless amateur engaged in experimental or other work where the need is constantly arising, for some purpose or other, for varying amounts of current at different voltages, the shunt switchboard should prove a useful piece of apparatus, as with it any voltage from zero to the full supply pressure, by as many intermediate steps as required, can be readily obtained.

This type of switchboard should appeal to a large number of readers, as it can be constructed by any worker of average ability, is simple in design, inexpensive, and when once set up and connected to the mains is always available for tapping off the required voltage.

In this article it is not proposed to fully describe the construction of such a board, but to only give sufficient data and information to enable anyone, who so desires, to design and build a board to his own individual requirements. As the output required by different workers will necessarily vary between very wide limits, it is not possible to give dimensioned details, but the worker will not find any great difficulty in proportioning the various parts to suit his own particular case.

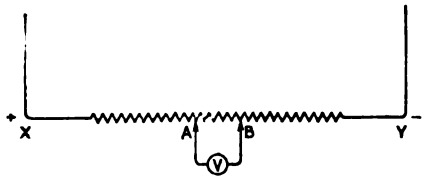


*Fig. 1. Showing Principle of a Shunt.*

To those who have no knowledge of the working of these boards, the principle of a shunt may be easily understood from a study of Fig. 1. Let X, Y, represent a fixed resistance connected between the supply terminals, and through which a current is flowing. If, now, another circuit is connected to two points along this resistance, a current will also flow in this second circuit, and the pressure will vary according to the position of the tapping points A, B. Let us suppose that the distance apart of the two points A, B, is one-fifth of the length of the resistance X, Y, then the voltage in the circuit A, V, B, assuming the supply pressure to be 250 volts, will be $250 \div 5 = 50$ volts. If A, B $= \frac{1}{2}$ X, Y, then the voltage in A, V, B, will be $250 \div 2 = 125$ volts, and if $\frac{1}{25}$ X, Y, the voltage will be 10, and so on, the voltage in the second circuit varying in direct proportion to the ratio of the lengths AB, XY. It is, therefore, obvious that if we provide X, Y, with a number of tapping points to which we can attach the circuit A, V, B, we can obtain any voltage we require from zero to the full supply pressure, and any current up to the maximum which can be carried by the resistance X, Y.

The general arrangement of a shunt switchboard is given in the diagram Fig. 2. The terminals E, F, are the main supply terminals, and connected

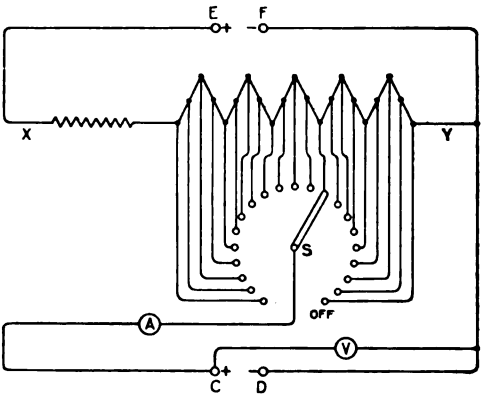


*Fig. 2. General arrangement of a Shunt Switchboard*

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directly across these is the resistance X, Y. Tappings taken at various points along this resistance are connected to the studs of the radial switch S, the switch arm being connected to the positive board terminal C, through the amperemeter A. The negative board terminal D, and the off stud of the switch S, are both connected to the negative end of the resistance X, Y, as shown. The voltmeter V, is connected directly across the two board terminals C, D, the instruments indicating the pressure and current actually being used.

To more fully understand the calculations necessary for working out the values of a board, we will

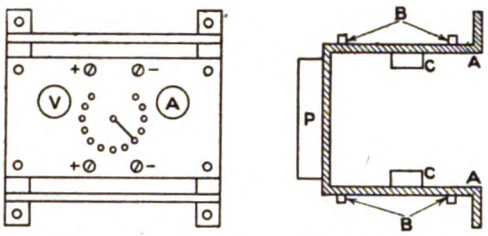


*Fig.* 3. *A simple arrangement of a Frame.*

suppose that a board is required capable of supplying 10 amperes at 100 volts, the voltage to increase from zero by multiples of 5, the supply pressure being 230 volts. The resistance of the coil X, Y, will be 230 ÷ 10 = 23 ohms, and by referring to a resistance wire table we shall find that to carry 10 amperes safely 13 S.W.G. Eureka wire will be necessary, this wire carrying 11·25 amperes with a temperature rise of 200° F. Eureka wire 13 S.W.G. has a resistance of about 1·3 ohms per pound, so that the total amount required will be 23 ÷ 1·3 = 17·5 lbs. (approx.). The length of 1 lb. of wire is roughly 43 ft., so that this length multiplied by 17·5 makes a total of 750 ft. for the complete resistance.

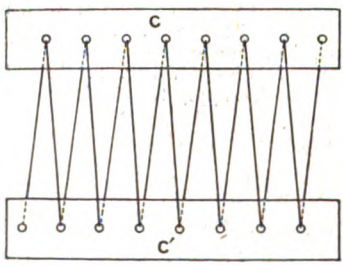


*Fig* 4. *Arrangement of the Coils.*

From what has already been explained, it will be understood that in order to obtain a pressure of 5 volts we must take our tapping from two points, which measure 230 ÷ 5 = 1/46th of the total length of the resistance, and this will be 750 ÷ 46 = 16⅓ ft. Therefore, to obtain the 100 volts required, 20 tapping points, 16 ft. 4 ins. apart will be necessary. In practice the resistance X, Y, would be made up of a number of coils of equal length, suspended in a frame, and so connected as to form a continuous length from which tappings would be taken at the correct points to the radial switch. In the example just given the resistance would be composed of 23 coils each 32 ft. 8 ins. long, the 20 tappings being taken from the first 10 coils, as shown in Fig. 2.

A few points concerning the actual construction of a board will now be considered. The size of the board will, of course, be determined by the length and number of the resistance coils, but these having been decided on, the dimensions of the frame can be easily obtained. A simple type of frame is shown in the diagram Fig. 3. It consists of two iron brackets A, of fairly stiff section, bent to the shape shown, and held in position by the four iron bars B. The resistance coils are suspended between the two slate bars C,C′, a compact method of fixing and arranging the coils being shown in Figs. 4 and 5. The distance apart of the bars C,C′,

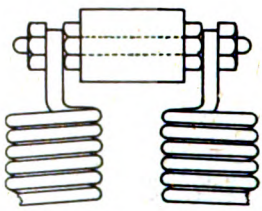

*Fig* 5. *Connections of Coils.*

should be such that the coils, when stretched between, form a fairly open spiral. If tappings are required at other points on the coils than at the various junctions, a good method is to divide the coil and bolt together, the connections being taken from these joints. A divided coil is shown in Fig. 6.

The front panel P, should be of slate, and is fitted with a suitably calibrated voltmeter and amperemeter, radial switch and two pairs of terminals. The general arrangement of the panel is given in Fig. 3. The connections from the resistance to the radial switch, etc., must be heavy enough to carry the maximum current safely, and care taken that all coils and connections are perfectly free and tight.

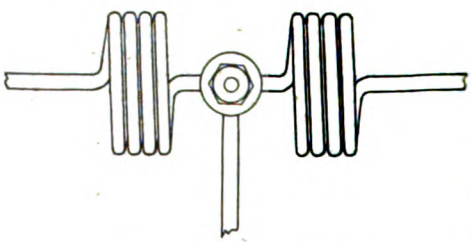

*Fig.* 6. *A Divided Coil.*

It is essential to insert a main switch in the supply circuit to completely isolate the board when not in use as, all the time the circuit is closed the total amount of current for which the resistance is designed is being consumed, however much or little you are actually taking from it.

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# Amplification of Telephony

## DEMONSTRATION AT A LONDON CINEMA

A very interesting demonstration was given by Mr. Basil Davis (**2 BZ**) in the hall of the Pavilion Cinema, Marble Arch, W., on Friday, July 7th, using an arrangement which he has devised for rendering low power telephony transmission audible to a large number of persons.

The demonstration was preceded by a series of very attractive films, shown by means of moving diagrams. The production of oscillations by valve circuits, their modulation, and the reception of the modulated waves were represented in such a way that anyone could immediately grasp the general principles of wireless telephony.

By arrangement with Lieut. H. S. Walker (**2 ON**), music was transmitted from his station, which included two songs by Mr. Gilwyn Evans, the well-known tenor. The reception in the Cinema was remarkably good, and Mr. Davis is to be complimented in developing an arrangement capable of giving such great amplification, the music being easily heard by all those present, who were mostly seated at the far end of the hall. The modulation was particularly good, and the combination of voice and piano, especially the maintaining of their relative strengths, being exceptionally well carried out. It was unfortunate that a little jamming occurred near the end of the transmission, due, no doubt, to the use of reradiating receivers by other experimenters who were tuned in to the transmission.

Below is a description of the apparatus at Mr. Davis's station.

For the sake of compactness, safety, etc., it is contained in a roll-top desk. This was gutted out, and standard receiving and transmitting sets installed inside, including H.T. and L.T. batteries. The whole can be locked up, to protect it from any curious folk that may use the room.

The aerial is a perpendicular twin wire about 60 ft. long with a very short lead-in. It is suspended from a steel cable stretched between tall buildings on either side of the theatre.

The receiver consists of one H.F. amplifier, detector and three L.F. valves for magnification. Any of these may be switched in separately. Tuning is done by Burndept coils and condensers. Either single circuit or secondary and aerial circuits may be used, controlled by switches. A Brown's

**2 BZ.** *Mr. Basil Davis's Station at the Pavilion Cinema, Marble Arch.*

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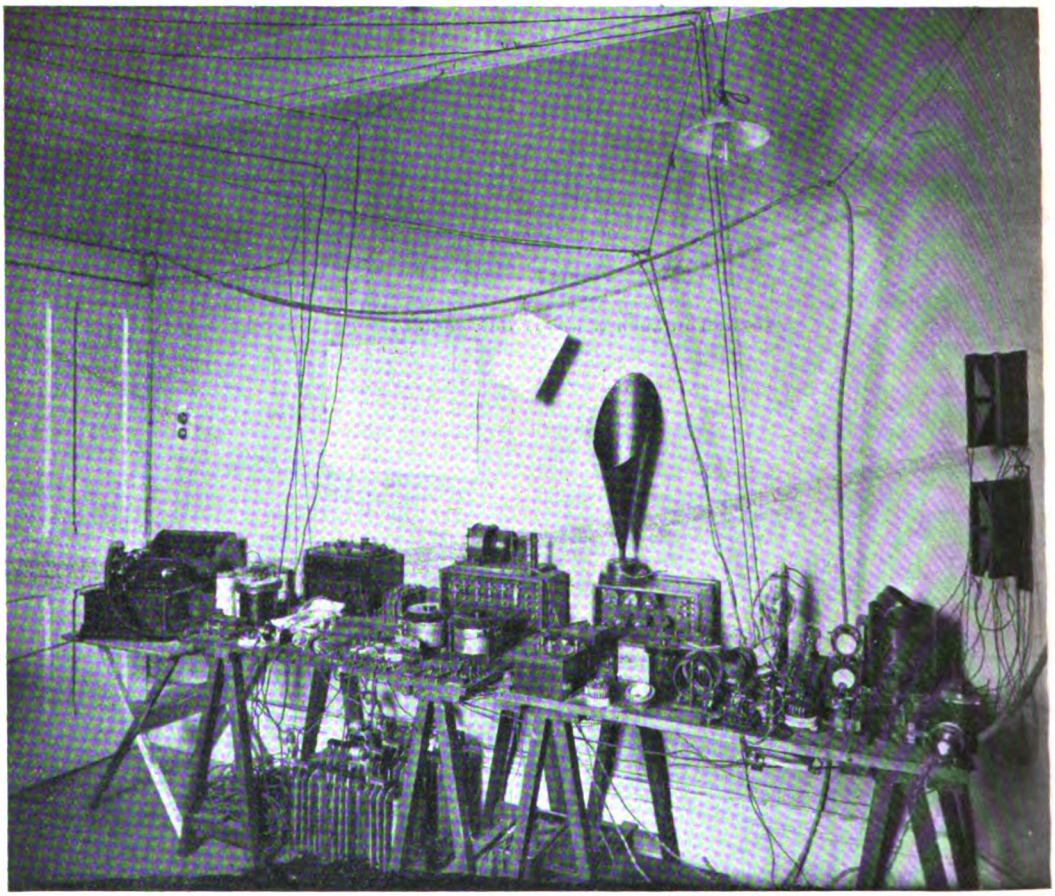

*The Transmitting and Receiving Equipment of* **2OM**, *at Brentford.*

loud speaker is installed, but reception is usually done on the "Magnavox," the American loud speaker, to be seen on top of the desk in the photograph.

For transmitting the well-known choke control method is used, and sometimes the patent circuit of Lieut. Walker (**2OM**). For high tension a Mackie generator is employed, direct coupled to a high-speed ¼ h.p. D.C. motor (seen above the desk on wall brackets). This supply is effectively smoothed by a 2 microfarad waxed paper condenser, which is taken from an old 12-in. spark coil. A certain clarity of modulation in speech and music is obtained owing to the special microphones used. Mr. Davis usually transmits most week-day evenings after 8.30 p.m.

A photograph of the transmitting equipment is shown above, and it is hoped in the near future to give more information concerning this station.

## LIST OF EXPERIMENTAL STATIONS.

There has been a ready response to our request for additions and corrections to the List of Transmitting Stations published in our issue of July 1st. Will those who have not yet forwarded particulars kindly do so.

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# Receiving Circuits

By CRISPIN C. REDSHAW, Assoc.I.R.E.

SINCE recently reading a paper entitled "Receiving Circuits" before the King's College Wireless Society, and its subsequent publication in the pages of the *Wireless World*,* I have had quite a number of enquiries for further information on various points in connection with the circuits I described. Hence I am of the opinion that the following few notes will be of assistance to amateurs generally, especially as the majority of the information to be given has not yet appeared in print.

To begin with, in Fig. 1, the function of the 10,000 ohms resistance, which is the resistance not lettered in Fig. 1 (Fig. 13 in my previous article), a non-inductive one, of the type usually employed for anode resistances in the resistance-capacity coupled circuits, seems to be obscure. It is inserted to aid reaction on short wavelengths. Its insertion causes greater potential variation at the anode of the second valve, the point from which reaction is obtained, in the same manner as the resistance in the anode circuit of the first valve causes large potential variations at point A for impression on to the grid of the second valve *via* the intervalve capacity C. The exact value of this resistance

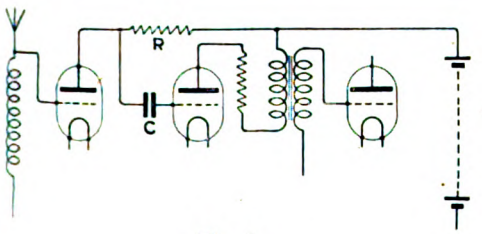


*Fig.* 1.

will be decided by the type of valve employed as No. 2, H.T. volts, impedance of primary and secondary of note magnifier transformer, etc.

The next thing I wish to point out is that the two curves (Fig. 3 in my previous article) have been accidentally interchanged, *i.e.*, that labelled "auto-transformer" should be "coupled," and *vice versa*.

I will now deal with another circuit—quite a standard circuit, certainly, but one which can be made to give very excellent results on all waves and for all purposes. It is outlined in Fig. 3. The circuit is well known, so I will leave out the general principles underlying its action and confine myself to those particulars which are usually neglected by the average writer. In particular, I wish to deal with coil L. This is an auto-transformer, and is shunted (optionally) by condenser S. The design of this coil plays an important part in the satisfactory working of the set as a whole. It should be made as small as possible and placed so that it has little capacity to other parts of the set, especially to wires and apparatus conveying or dealing with audio-frequency impulses. I have made up coils for this purpose wound "in air." This needs explanation. The usual method of winding these coils is either (i) ordinary single-layer solenoid; (ii) pile wound, basket wound or

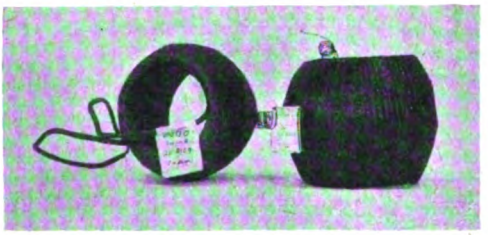

*Fig.* 2.—*H.F. Auto-transformers. Left*: 2,000 *turns* 28 *S.W.G. enamelled copper. Right*: 2,000 *turns* 26 *S.W.G. enamelled copper. Internal diameter* 2¼".

honeycomb wound on an insulating former of wood, ebonite or other material; (iii) pile wound, basket wound or honeycomb wound, but without former. I favour the latter—the pile wound coils in air—as I have found them better than all those classed in group (ii). Group (i) coil is suitable only for short waves, while group (iii) coils are usually difficult or tedious to manufacture, with that one exception.

My method of winding these coils is as follows. Procure a former of any material, circular cross section, diameter about 2" or 2½". The wire is pile wound on to the required number of turns,

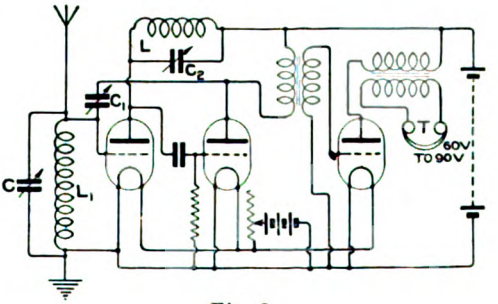


*Fig.* 3.

the whole slipped off the former and taped up with ordinary white tape in a manner similar to that employed for armature winding, shellaced and baked. The cross section of the resulting coil should be somewhat as shown in sketch (Fig. 4).

ELECTRICAL PARTICULARS.

Gauge of wire anything between 26 S.W.G. and 36 S.W.G. No. 28 S.W.G. is a very convenient size.

* Vol. IX, page 724.

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Flexible ends should be well soldered on for connections outside the coil. Increasing gauge of wire from 28 S.W.G. to 26 S.W.G. gives unnoticeable increase of strength of signals; decreasing gauge from 28 S.W.G. to 36 S.W.G. weakens signals about one strength.

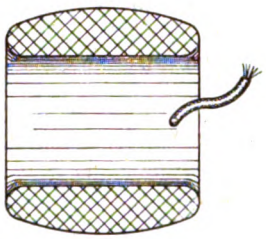

*Fig. 4.*

CALIBRATING.

Having made up the coil it must be calibrated. This is quite easy to do in the following manner. We will start with assuming that the set as a whole is not calibrated for wavelength. This must be done first. Curves are given showing the form the calibration will take, and are obtained as follows. Insert an 85,000 ohms (approximately) resistance in place of L. Set condenser C at zero value and inductance M at shortest wave, *i.e.*, stud 1. Listen-in for C.W. and adjust C till generated oscillations are equal in frequency to the wave being received, when no sound will be heard in telephones. Note position of pointer of C, and determine origin of and consequently wavelength of the signal by listening for call sign. Do this for as many stations as are available, using stud 1 and various settings of condenser, at all times being *just on the oscillation point*. Repeat for studs 2, 3 . . . and plot curve for each stud as shown in Fig. 5. There will be an "overlap" *a* between consecutive studs. This overlap should not exceed, say, 30 degrees of condenser. If it does, your tuning apparatus is not functioning at the height of its efficiency unless the capacity C is very small. However, the set as a whole being calibrated, we turn our attention to the auto-transformer in question. Take out resistance and connect in the transformer. Set aerial circuit to any wave and couple up with condenser K till oscillations commence. Decrease value of K till they just cease. Re-tune aerial till they again start and cut out more of K till they stop. Again

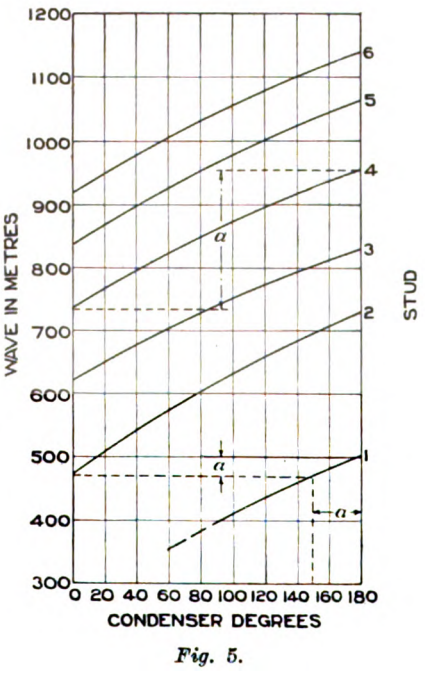


*Fig. 5.*

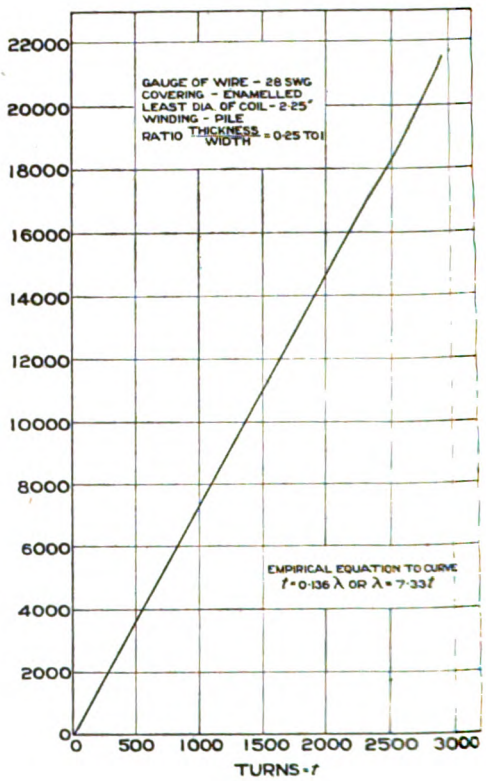


*Fig. 6.*

re-tune and cut out K, and by repeating this process a point will be found when a minimum value of K is obtained which will *just* cause oscillations on a particular valve, and by either increasing or decreasing this wave the oscillations will stop. Refer this adjustment to calibration curves of set and determine wavelength. This will be the most efficient wavelength of the auto-transformer. Do this with several different transformers and plot a curve, as in Fig. 6, showing the relation existing between *number of turns* and *wavelength*. Verify that it follows a *straight line law* for all ranges of wavelength between 400 metres and 25,000 metres.

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One of these calibration curves is given herewith, where the diameter of former used was 2¼" and 28 S.W.G. enamelled wire. One can now wind a coil for any desired wavelength by reference to the curve, which is a point of great importance to the serious-minded amateur. A table is appended, giving further details of these transformers, which may be of assistance :—

HIGH-FREQUENCY AUTO-TRANSFORMERS.
No. 26 S.W.G. Enamelled Copper.

| Turns. | Depth over-all (inches) | Average thickness over-all (inches) | Wave-length (metres) | Weight complete (ounces) |
|---|---|---|---|---|
| 85 | 0·31 | 0·31 | 580 | 1 |
| 150 | 0·5 | 0·31 | 1,100 | 1·75 |
| 400 | 0·88 | 0·25 | 2,900 | 4·5 |
| 500 | 1·0 | 0·25 | 3,600 | 5·5 |
| 800 | 1·13 | 0·38 | 5,800 | 8·75 |
| 1,000 | 1·38 | 0·5 | 7,200 | 11·25 |
| 2,000 | 2·75 | 0·5 | 14,600 | 22·5 |

These transformers may also be wound in sections if desired, though this is not such an economical proposition as that already described. For instance, a certain coil was wound in two sections, taped up separately and taped together concentrically in two ways : (i) both windings in the same direction (compounded), and (ii) windings in opposite directions (differential). Both coils were the same size. The effect of the arrangement (i) was to increase the wavelength by about 10 per cent. of that of the two coils taken separately, and of arrangement (ii) to decrease it by the same amount. The only advantage gained is in ease of winding.

It will be noticed that coils calibrated on one valve panel will not necessarily give the same wavelength results on another. The capacity of the valve panel due to its mechanical construction and the disposition of its component parts is the deciding factor. The calibration curve given refers to a 3-valve panel having a standard R.A.F. 0·0004 mfd. intervalve capacity between "1" and "2" valves, the valve-holders being 3½" apart (centre to centre) and leads being perfectly straight short wires.

# Valves, and the Juice to give Them

By G. P. KENDALL, B.Sc.

THE first thing that the purchaser of a valve requires to know is what voltage to apply to filament and plate. The experienced valve fancier, of course, obtains this information for himself by experiment ; but the novice is in a different position, and often has disheartening experiences trying to run a six-volt valve from a four-volt accumulator, or striving to pacify a low-plate voltage valve which will do nothing but howl (he having given it the provocation of a 70-volt H.T. battery).

To assist such beginners some good working values for the commoner types of valves are given below. They may require a little modification to suit particular circuits and individual valves, but may be taken as satisfactory starting-points to be improved upon when experience has been gained :—

| Valve. | Filament Volts. | Plate Volts. R. | H.F. (*a*) | L.F. | H.F. (*b*) |
|---|---|---|---|---|---|
| French R | 4 | 40 | 50 | 70 | 80 |
| ES2 - | 6 | 30 | 35 | 40 | 50 |
| ES4 - | 4 | 50 | 60 | 70 | 90 |
| ORA - | 4 | 30 | 30 | 50 | 50 |
| V24 - | 6 | — | 30 | 40 | 50 |
| Marconi-Osram R4B - | 6 | 60 | 70 | 80 | 100 |
| | 4 | 50 | — | — | — |

R denotes voltage when the valve is to rectify.
H.F.(*a*) denotes voltage when the valve is to amplify at high frequency with transformer coupling.
L.F. denotes voltage when valve is to amplify at low frequency.
H.F.(*b*) denotes voltage when valve is to amplify at high frequency with resistance-capacity coupling.

## A Method of Increasing the Life of a Valve

The circuit diagrams (Figs. 1 and 2) relate to the article which appeared on page 448 of our last issue, and it is regretted that they were omitted, owing to a delay in their preparation.

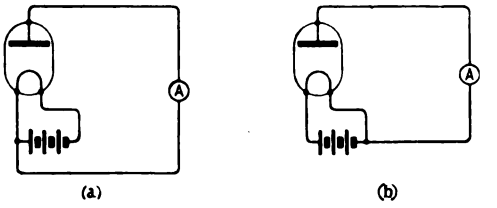


*Fig.* 1.

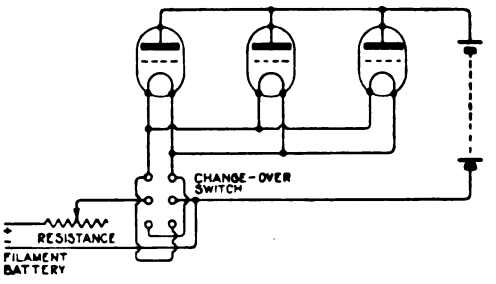


*Fig.* 2.

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# Notes

### Transmitters: Official Figures.

In the House of Commons it was stated by the Assistant Postmaster-General that up to June 3rd approximately 11,000 receiving and 450 transmitting licences had been granted. He hoped to make a statement shortly on the question of a complete scheme for broadcasting, but as yet the matter was still under discussion.

### Air Ministry Demonstration at Agricultural Show.

At the Royal Agricultural Show held at Cambridge, which is of world importance, the Air Ministry, in conjunction with the Cambridge School of Agriculture, demonstrated the distribution of meteorological reports. The importance of keeping farmers and others informed of the anticipated weather was emphasised. Reports were received on the ground three times a day, and the data exhibited on a large chart. Deductions were made by an expert forecaster for the benefit of those attending the show.

### Wireless in Education.

That education in future must include early training in wireless is evidently recognised by education authorities. We learn that the Lowestoft Education Committee have granted permission to the headmaster of the Central School in that town to erect an aerial. Furthermore, the school managers have recommended that the apparatus be purchased out of the amount of money allowed by the committee for scientific teaching. The boys at the school under the science master, Mr. C. C. Culf, have made a complete set.

Many schools have given recognition to the place which wireless study should take in the everyday life of the pupils, but when the governing bodies in the educational world make a move toward including this phase of science in the school curriculum there is hope that the time is not far distant when the universal understanding of the fundamental principles will be prevalent. What is now a popular hobby will then be looked upon as child's-play, and the student will seek experiment not in fields now only traversed by a few highly qualified scientists, but in a general realm of science from which still higher platitudes will be sought.

### P.M.G.'s Power to Prescribe Licence Fees.

Sir Douglas Newton in the House of Commons, referring to the Wireless Telegraph and Signalling Bill, said the Postmaster-General indicated that the Bill is generally one to make permanent the powers he has hitherto possessed. "In one or two important details the Bill breaks new ground," he said. "One is that power is taken by the Postmaster-General to prescribe, subject to the consent of the Treasury, the fees to be paid in respect of the grant or renewal of any licence or certificate. That, presumably, governs the licences now required, for which a fee of 10s. is chargeable, in respect of all the wireless receiving sets. Would it not be possible to add to the clause a provision that any regulations which increase the fees chargeable are to be laid on the table of the House? It is most important that the receiving stations should not be hampered in any way."

### Sainte Assise (UFT).

A correspondent notifies us that Sainte Assise, with call **UFT**, has commenced transatlantic working on a wavelength of approximately 1,500 metres. H.F. alternators are used; the signals are very strong.

### Wireless to Entertain St. Dunstan's.

On Friday and Saturday, July 7th and 8th, some excellent telephony was transmitted by the Marconi Company to St. Dunstan's, Regent's Park. A large number of prominent artists gave their services, with the result that a splendid entertainment was provided for those assembled at St. Dunstan's, as well as all those who listened-in to the transmission.

### Bedford Physical and Radio Society.

Mr. C. W. Clarabut, Hon. Secretary of the above Society, informs us that during the last two months considerable success has attended their efforts. They now have over 80 members, and Mr. Rupert S. Allen is the President.

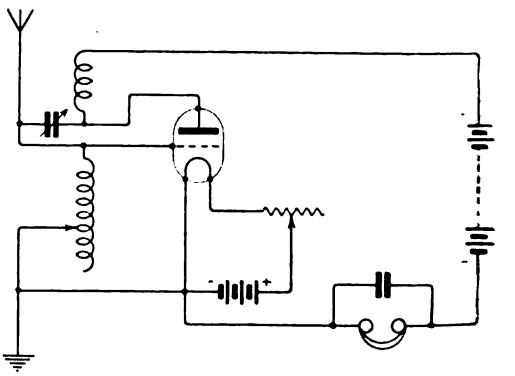
# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with considerable interest the article in the June 17th issue entitled "Some Effects of Capacity on Mutual Induction," by J. H. Reeves, M.B.E., as for the past six weeks I have been using a somewhat similar circuit for short waves.

Rough tuning is done quickly with the reaction condenser, fine tuning with magnetic reaction, then finally the set is stopped from oscillating by reducing the filament current of the detector valve.

The performance of the set is very good—very easy to operate, very stable, and very easy to bring to position of just not oscillating and therefore greatest magnification of speech and music without distortion. **2 FQ** and **2 ON** are very loud and clear using two valves—1 rect., 1 L.F.—and can easily be heard 25 ft. from 'phones. (Station, Wimbledon



Park; aerial, temporary, 40 ft. double wire, 40 ft. high lead-in end, 20 ft. high free end, badly screened by house.)

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The method of tuning by alteration of filament current is, in my experience, badly neglected by amateurs.

The two inductance coils are two Mark III short wave coils, *not* rewound. The capacity reaction is a small Mark III condenser of 0·00055 mfd. capacity (max.).

It is possible to receive Croydon and the Hague on this short wave set by increasing the capacity reaction, the Hague being reasonably loud on one valve.

By using the Mark III condenser (0·00055 mfds.) as capacity reaction instead of for tuning the reaction coil, much better results are obtained and the set is more stable.

The following might be of interest:—

No A.T.C. is used.

| Wavelength. | 300 | 320 | 400 | 600 | 900 | 1050 | Metres. |
|---|---|---|---|---|---|---|---|
| Capacity - | 0 | 10 | 18 | 44 | 148 | 180 | Degrees of Condenser of 0·00055 mfd. |

The above with magnetic reaction at right angles to A.T.I.

A. CASTELLAIN,
*Treasurer and Asst. Hon. Secretary,*
City and Guilds Wireless Society.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The question of the use of fine wire coils in reacting valve circuits has been dealt with in a recent paper by Mr. J. H. Reeves, but their use in crystal reception is of course quite different. Coils wound with No. 22 to No. 26 S.W.G. are usually recommended for use in the aerial circuit when using a crystal detector, to eliminate undue damping.

I have been experimenting in this connection recently, and find no appreciable difference in range or strength of signals when using No. 36 wire instead of No. 24 in a direct coupled tuner. I have now wound a basket coil for 600 metres with No. 47 S.S.C., and while signal strength has decreased slightly, my receiving range is still quite good. With a 70 ft. twin wire aerial of an average height of 30 ft. in open country, using this coil and a zincite-copper pyrites detector, it is possible at night to read most 600 metre stations as far south as Las Palmas (**EAL**), also several of the Mediterranean stations, signals being of a very fair strength.

I must apologise for trespassing on your space, but the use of these coils being contrary to normal practice, I thought the above details might possibly be of some interest to your readers.

C. H. AITKEN.

# Book Review

DIRECTIVE WIRELESS TELEGRAPHY. By L. H. Walter. (London: *Sir Isaac Pitman & Sons, Ltd.*)

This book forms a valuable addition to Pitman's well-known technical primers. The book assumes on the part of the reader a general acquaintance with the theory of Wireless telegraphy, and the special branch of the subject under consideration is therefore treated without any preliminaries of introduction.

In the opening chapter the author sets forth some of the principal advantages of directive transmission and reception, and later proceeds to describe different types of aerials suitable for the purpose of both transmission and reception. The relative merits of these are considered and formulæ for different types of aerials are given.

Commercial types of direction finders are illustrated and described. In a concluding chapter some miscellaneous applications of directive wireless telegraphy are considered.

The book is well written and illustrated, and provides a complete guide to what has already been accomplished in directive wireless telegraphy, whilst giving very full references to sources from whence more detailed accounts of various systems and methods may be obtained. H.S.P.

# Calendar of Current Events

**Sunday, July 16th.**

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY.

Field Day.

Transmission of Telephony from 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, July 17th.**

LEICESTERSHIRE RADIO AND SCIENTIFIC SOCIETY.

General Meeting, Vaughan College, Leicester. Lecture on "Continuous Wave Transmission," by Mr. J. W. Pallett.

**Tuesday, July 18th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT** Writtle, near Chelmsford.

**Thursday, July 20th.**

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Detecting Devices," by Mr. E. V. R. Martin.

**Sunday, July 23rd.**

Transmission of Telephony from 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, July 25th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT** Writtle, near Chelmsford.

**Thursday, July 27th.**

RADIO EXPERIMENTAL ASSOCIATION. (NOTTINGHAM AND DISTRICT).

Meeting.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

**The Wireless and Experimental Association.***

A most successful public demonstration was given on June 22nd at the Central Hall, Peckham. Over 400 were present and greatly enjoyed music broadcasted for the Association's benefit by Marconi House, as well as the usual lot of amateur experimenters. Short lectures were given by various members, many of whom brought along their instruments for exhibition. Public queries were invited and fully answered by those on the Committee. Popular books on wireless were sold for the benefit of the visitors. One item worthy of comment was the appearance of a complete class from a near-by school who are studying wireless, and to whom the association look for future support and information. The whole evening from 7 till 10.30 was fully occupied and enjoyed by all present. Over 50 new members were enrolled as a sequel to the Association's broadcast appeal.

The meeting of the Association held the following Wednesday was spent giving valuable information to the large proportion of new members who turned up hungry for information. Although they did not go away satisfied, as it was impossible to impart all the necessary information in one evening, they eagerly looked forward to the next week. Although the membership has been so greatly augmented there is room to enrol and educate new members, be they novices or experienced.

**The Wallasey Wireless and Experimental Society.***

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

At the meeting of the Society held on June 22nd, Mr. J. C. Mason lectured on "Radio Frequency Amplification." He first dealt with the theory of H.F. amplification and its advantages and disadvantages as opposed to L.F. The lecturer drew a few transformer coupled circuits, treating each one in detail, also one or two resistance capacity circuits. During the discussion many interesting points were raised.

It has been arranged to hold the club meetings fortnightly until further notice, owing to so many members being away from home.

The first field meeting of the present session was held at Thursaston Hill on Saturday, July 1st.

**Paddington Wireless and Scientific Society.***

Hon. Secretary, Mr. L. Bland Flagg, 61, Burlington Road, Bayswater, W.2.

The third general meeting of the above Society was held in the lecture room of the Electrical Department, Paddington Technical Institute, on Thursday, June 22nd, at 7.15 p.m. It was gratifying to see the great majority of members in attendance.

After the Minutes of the last meeting and the monthly accounts had been disposed of, the Chairman announced that the Society had been fortunate in securing two papers for the evening.

The Chairman then called upon Mr. Marley, B.Sc., to read his paper on "Receiving Circuits." Mr. Marley commenced with the simple crystal circuit and gradually enlarged upon the subject, taking his audience through every known method of rectifying and amplifying wireless waves.

The paper was illustrated throughout, no less than 30 diagrams being used, and one could not help feeling that the lecturer had struck an original idea, for he handed round papers on which were drawn each one of the numerous diagrams, making the lecture easy to follow and at the same time giving a means of obtaining a great number of diagrams which must prove of great use for reference.

A discussion was opened in which further items were discussed, the most important of these being intervalve transformer ratios and magnitude of anode resistances.

Mr. A. L. Beak, A.M.I.E.E., then followed with his paper entitled "Oscillatory Circuits." This paper was also profusely illustrated and a number of experiments were shown, the whole being dealt with in a way that shows that the lecturer was more than familiar with the subject.

The Chairman pointed out that owing to the lateness of the hour it would be impossible to open the discussion but that would be done at the next meeting.

A hearty vote of thanks was proposed to the speakers of the evening, to which the members responded.

It is proposed to hold two field days during the summer, the first to take place on Sunday, July 16th, and the other to take place on Sunday, August 20th, 1922. Permission has been applied for and it is hoped that some gentleman will be good enough to transmit us a short programme.

The Society is now possessed of a receiving licence and the aerial is making good progress.

The affiliation to the Wireless Society of London is now complete.

The Secretary will be pleased to hear from any amateur who has not yet connected himself with any society, and will assist him in any way that lies within his power.

The date of the next general meeting will be announced later.

**Wireless Society of Highgate.***

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemore Avenue, East Finchley, N.2.

Mr. J. Stanley, B.Sc., A.C.G.I., gave the third of series of lectures on the elementary theory of his wireless telegraphy and telephony on Friday, 23rd June, when there was again a large attendance of visitors.

After briefly alluding to the different types of aerials and indicating the functions of the earth connection, Mr. Stanley went on to deal with tuned circuits. He showed how, by coupling a

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coil in an oscillatory circuit with a coil in another circuit, oscillations could be induced in the second circuit, and that these oscillations would have maximum strength when the natural frequency of the second circuit was the same as the natural frequency of the first circuit. He pointed out that by this means energy could be transferred from one circuit to another, the amount of energy transferred being largely governed by the tightness of the coupling between the coils.

Mr. Stanley went on to show that the closed circuit coupled to an aerial circuit is such an arrangement, and since in this case it is desired to radiate as much energy as possible from the aerial, he dealt with various methods employed in practice to prevent the energy transferred from the closed circuit to the aerial circuit being re-transferred back to the closed circuit, mentioning in particular the rotary and quenched spark gaps.

He then passed on to consider the receiving station, and showed how electro-magnetic waves impinging on the receiving aerial produced oscillations in the aerial circuit, and that these oscillations would be of maximum strength when the receiving aerial was tuned to the same frequency as the transmitting station. He pointed out the various methods of increasing or decreasing the natural frequency of an aerial by suitable combinations of inductance coils and condensers.

At the conclusion of the lecture, the whole of which was followed with great interest by the audience, a cordial vote of thanks was given to Mr. Stanley, and after seven new members had been elected—including two ladies—the meeting was adjourned.

On Friday, 30th June, Mr. F. L. Hogg gave the first of his series of lectures on "The Construction of Wireless Apparatus" at a meeting of the Society at their headquarters at the Highgate Literary and Scientific Institution.

Mr. Hogg dealt very carefully and lucidly with the construction of tuning coils and contrasted the relative merits of cylindrical, basket and honeycomb coils for various wavelengths. He showed how a simple one-valve circuit should be connected up and then dealt in detail with the assembling of the various components which go to make up such a set.

Mr. Hogg's lecture was followed with great interest by those present, and after a few questions had been put and answered, a hearty vote of thanks was proposed and carried with acclamation.

The lectures on the theory of wireless and the construction of apparatus are being continued each Friday until the middle of August, and the Hon. Secretary will be pleased to receive enquiries from anyone interested and to furnish full particulars of the Society.

### The Greenwich Wireless Society.*

A meeting of the above Society was held on June 6th, 1922, at the Rangers House, Blackheath.

In the absence of the President, Mr. Fergusson was invited to take the chair for the evening, who, after the usual business of the evening, gave the members present a very interesting account of the development of wireless in America by reading several extracts from letters received from his son, who is staying there. Mr. A. Bartle then gave an address on broadcasting, giving some very useful diagrams of suitable receiving circuits which were very much appreciated.

A letter was then read from Mr. Bartle tendering his resignation as Hon. Secretary owing to the pressure of business, which, after some discussion, he agreed to withdraw until the end of the session, Mr. W. G. Kimber being provisionally appointed to act as Joint Hon. Secretary in the meantime.

Two new members were elected and the meeting was adjourned until the first Tuesday in October, 1922, at 7-45 p.m.

Hon. Secretaries, Messrs. A. Bartle and W. G. Kimber. All communications to be addressed to Mr. W. G. Kimber, 39, Bargery Road, Catford, S.E.6.

### Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The monthly meeting of the above Society took place at the Woolwich Polytechnic Institute at 8 p.m. on Friday, June 30th, 1922.

Mr. W. T. James, who was to have given a paper, was unable to be present, being unwell in health and the Secretary therefore arranged a concert.

Promptly at 8 o'clock **2 AQ** opened the concert by calling up and sending some fine music. He was followed at 8·10 by **2 OM**, at 8·20 by **2 KT**, at 8.40 by **2 ON**, at 9 p.m. by **2 BZ**, and at 9.20 by **2 LT**. Thus from 8 o'clock to 9.30 the Society was entertained with music and telephony, which was received very successfully To all the gentlemen concerned the Society tenders its best thanks. Considerable interference was experienced, particularly from "howling" valves. Evidently other amateurs in S.E. London were trying to get the music as well.

### Dartford and District Wireless Society.*

Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Dartford.

The activities of the above Society for the month of June are reported as follows:—On Friday, June 2nd, the usual fortnightly meeting was held with the Vice-President, Mr. J. R. Smith, M.I.E.E., in the chair. A general discussion on wireless matters took place and members had an opportunity of seeing crystal and valve sets in operation.

A wireless demonstration was given on Wednesday, June 14th, at a garden party at Dartford, which was held from 3 to 9 p.m. A three-valve experimental L.F. set and five-valve sets were made use of on this occasion. Telephony was clearly received and made audible by means of a loud speaker. The demonstration was very successful and aroused considerable interest.

The usual meeting was held at Dartford Grammar School on Friday, June 16th, Mr. J. R. Smith, M.I.E.E., in the chair. Seven new members were enrolled. There was a demonstration of violet ray apparatus, given by Mr. Phillips, and also a Trench transmitting and receiving set and a coil winder were shown by Mr. Pernett.

A wireless demonstration was conducted at a garden party in aid of "Waifs and Strays," given on Wednesday, June 21st, at Wilmington Hall, the residence of Lord and Lady Dudley Gordon.

This demonstration was even a greater success than the previous one. A regulation twin aerial



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had been erected and the apparatus used was a two-valve reactance set with a two-valve L.F. amplifier, a five-valve set, a three-valve L.F. and one H.F. amplification. By means of loud speakers telephony was not only heard in the demonstration room but also in the garden, a loud speaker being suspended from a tree.

Mr. Burnham, of Blackheath, very kindly gave a special transmission of music, which was received splendidly. The Society's best thanks are due to him for his kind assistance. Telephony from Marconi House, also from Eiffel Tower, was clearly received.

A high frequency coil with fluorescent tubes was demonstrated as an additional interest.

On Sunday, June 25th, by arrangement with the Air Ministry, a visit was made to Croydon Aerodrome. After a splendid charabanc journey the aerodrome was reached at 3 p.m., where plenty of interest was soon found. The wireless installation was very kindly explained by the officials in charge. A very interesting and instructive time was spent.

The usual fortnightly meeting was held on Friday, June 30th, at which Dr. L. J. Miskin, M.D., F.R.C.S., presided. A demonstration set, as used at Wilmington Hall, was placed in operation, also a two-valve set made by Dr. Miskin. Very good telephony and signals were received. New members continue to be enrolled and local interest is improving.

**Birmingham Experimental Wireless Club.***

At a meeting held on Friday, June 16th, at Digbeth Institute, Birmingham, a lecture was given by Mr. S. H. V. Abbott, on "Wireless at Sea." Mr. L. J. Dore, Vice-President, took the chair at 7.45 p.m.

Mr. Abbott, in the course of a most interesting and instructive lecture, described wireless systems and methods since the earliest days of marine wireless. He was accorded a hearty vote of thanks.

The monthly "General Discussions" was held at Digbeth Institute on Friday, June 30th. Thirty-two members were present.

The Hon. Secretary, having read the Minutes of the previous meeting, these were confirmed, and the discussion was opened by Mr. B. A. Matthews.

Mr. Matthews' valve receiver was discussed and criticised at length. Several other members then mentioned difficulties which they had met, and these were discussed by the meeting. Several interesting and original ideas were described by members.

Meetings are held at Digbeth Institute fortnightly at 7.30 p.m. on Fridays. The Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, will be pleased to hear from intending members.

**Bradford Wireless Society.***

A meeting was held at Headquarters at 7.45 p.m. on June 30th, Mr. W. C. Ramshaw in the chair. The minutes of the previous meeting were read and passed, following which a few new members were elected.

The Chairman called upon Mr. H. G. Evans, of the Bradford Technical College, to give a lecture on "Electricity and Matter." This subject, as everyone knows, is an exceedingly difficult one to deal with in a simple manner, but Mr. Evans certainly succeeded in presenting his subject in a most attractive way.

The lecture was admirably illustrated by experiments—including Faraday's well-known one of passing electricity through solutions—and also by means of lantern slides.

At the conclusion a hearty vote of thanks was accorded the lecturer and the proceedings terminated.

This meeting ended the session, but the rooms are open every fortnight as usual for informal meetings, elementary lectures and Morse practice.

The Committee wish it to be known that persons interested in wireless work and under the age of 18 will be welcomed as Associate Members of the Society. Names of such should be proposed by a member in the usual way, or application made to the Secretary.

**Middlesbrough and District Wireless Society.***

At the 32nd meeting of the above Society, held at its meeting room in Borough Road East on Monday, June 26th, at 7.30, Mr. W. B. Ward gave a very interesting lecture on "High Frequency Currents."

He fully explained some elaborate experiments which he has recently carried out, and pointed out some curious phenomena which he has found when working his apparatus. One very extraordinary effect which he pointed out was that the frequency of alternation produced by his apparatus was such that he was able to pass sparks 18 inches in length from the apparatus to his bare hand without pain, the only sensation being that of warmth at the hand. Another of the curious effects which Mr. Ward explained was that in a reasonably shaded room the top of his apparatus gives off a magnificent display in the form of an extensive blue glow, known technically as the "silent discharge," which is seen on rare occasions on ships' masts and at the points of lightning conductors during a storm.

Mr. Ward further explained the principal theories with regard to high frequency currents and the instruments now in use for producing them, many of which instruments are in regular use for the purpose of wireless telgraphy and telephony. At the conclusion of the lecture, Mr. Ward was accorded a very hearty vote of thanks.

A meeting of the Wireless Committee was then held whilst the other members listened-in on the wireless set of Mr. C. E. Thewlis, connection being made to the aerial which was raised to a new mast, 55 feet high. This new mast is to form part of the Society's permanent aerial, on which it is hoped to receive the broadcasting messages at a high standard of perfection.

Hon. Secretary, Mr. Cleveland Hood, Nunthorpe, S.O., Yorks.

**Cardiff and South Wales Wireless Society.***

Hon. Secretary, Mr. P. O'Sullivan, 16, Adamsdown Square, Cardiff.

One of the most successful of wireless demonstrations held this year was that inaugurated by the Cardiff and South Wales Wireless Society at the Cory Hall on Wednesday, June 21st. It is interesting to note that this demonstration was the first public one of its kind to be held in South Wales.

To a large and highly attentive audience (numbering over a thousand people) Mr. E. Ogden A.M.I.E.E., a Post Office Engineer, lectured in a simple, non-technical manner on the principles of wireless telephony.

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Mr. R. O. Sanderson (ex-President of the Cardiff Chamber of Commerce) was in the chair, supported by Capt. C. Crompton (Post Office Superintendent Engineer), Mr. F. Jones, and many other notable South Wales personalities.

The Chairman, upon introducing the lecturer, enlarged upon the value of the new science to commerce, and mentioned various new possibilities arising in that and other directions. He asked the support of the public for the Society which had done so much for the furtherance of wireless studies in the principality.

Mr. Ogden dealt in a light and concise manner with the first principles, and pointed out many of the difficulties arising during amateur experience, showing how they could be overcome. He invited the questions of the audience; and from the large number that were asked, it was clearly indicated what interest was being taken, and how successful the lecturer was.

For the purposes of the demonstration that followed, the Marconi Company very kindly provided apparatus and demonstrators, the Wireless College, St. Mary Street, being used as the transmitting station.

At the Cory Hall an amateur receiving set, the property of Mr. H. F. A. Sanderson, was also in use, and musical items contributed by prominent local artistes were rendered audible over the spacious auditorium.

During the demonstration Sir William Diamond, K.B.E., by means of wireless telephony, strongly appealed for the public support of the forthcoming Alexandra Rose Day.

The Chairman, at the conclusion of a very successful evening, and amid much applause, moved a vote of thanks to Mr. Ogden for the very able manner in which he had given his lecture. The motion, before being carried unanimously, was seconded by Mr. F. Jones.

The thanks of the Society were extended to the local Y.M.C.A. officials for the valuable assistance rendered by them.

### Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A general meeting was held on Friday, June 23rd, at the Leeds University, Mr. A. M. Bage (Vice-President) taking the chair at 8.0 p.m. The Chairman informed the meeting that it had been found impossible to arrange a discussion on "Direction Finding" as scheduled in the syllabus, but Mr. G. P. Kendall, B.Sc. (Vice-President), had very kindly come forward and the Chairman had great pleasure in calling upon Mr. Kendall to describe "A Four-Valve Receiver."

This set, as Mr. Kendall explained, was still in the experimental stage, being assembled in the well-known 50-watt trench set cabinet, and utilising some of this set's components. The first valve functions at radio frequency, having potentiometer grid control, and is directly coupled by means of reactance-capacity or resistance-capacity methods to the grid of the rectifier, which functions on the grid condenser system. The set is provided with magnetic regeneration taken from the plate side of the rectifier to the aerial circuit, which will provide for the reception of continuous waves if the coupling be tight enough to set up self-oscillation or autodyning. Two stages of low-frequency magnification follow, and by means of a plug and jack combination, the telephones or loud speaker may be placed in the plate circuit of either the rectifier, the first L.F. or the second L.F. valves. The receiver uses "R" valves and will function on all wavelengths, being very useful for telephony reception. Theoretical and practical diagrams of the scheme of connections were explained briefly, but clearly, by the lecturer.

A short discussion followed, at the close of which Mr. Kendall was heartily thanked for his very interesting and instructive lecture. The meeting then broke up and adjourned at 10 p.m., after the apparatus on view had been closely examined by all present.

### The Ilford and District Radio Society.

On Thursday, June 29th, Mr. J. E. Nickless, A.M.I.E.E., assisted by Mr. F. Grover, gave a lecture and demonstration on "Wireless Workshop Hints."

Both these gentlemen are of the pre-war school of amateurs, accustomed to making things themselves instead of purchasing them, and after giving much useful information on the correct method of using tools and explaining many makeshifts by which considerable expense could be saved, proceeded to show, with explanations as to the method of manufacture, wireless instruments made by themselves from odds and ends usually regarded as of no value.

Mr. Grover's description of a crystal set capable of receiving ship traffic and meteorological reports from the Eiffel Tower made at an inclusive cost of less than 10s. was greatly enjoyed. The telephones, which invariably defeat the efforts of amateurs endeavouring to produce cheap sets, did not conquer Mr. Grover, for he produced a single high resistance earpiece which had cost him 2s. to make. When tested by the audience it proved to be quite an efficient article.

The Society's programme for the coming session has now been completed and includes many useful lectures. As before, the meetings are alternately "formal" and "informal," definite lectures being arranged for the formal nights, while the others are devoted to buzzer practice and junior constructional classes.

Hon. Secretary, A. E. Gregory, 77, Khedive Road, E.7.

### Birmingham Y.M.C.A. Wireless Club.

Hon. Secretary, Mr. R. Jenkinson, Y.M.C.A., Dale End, Birmingham.

A wireless club, as above, has now been formed and appears to be progressing well, the membership numbering about fifteen.

The equipment at present consists of a two-valve receiving set, but it is hoped to improve on this in the near future, and during the winter months arrangements are being made for a series of lectures appertaining to wireless and general electrical apparatus to be given.

There are still vacancies in the Club for a few more members, and enthusiasts residing in the vicinity are invited. Applications to be made to the Secretary, who will be pleased to furnish full particulars.



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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"INEXPERIENCED" (East Sussex)** *encloses a sketch of circuit and asks* (1) *If it would receive the Hague Concerts with a 50′ double wire aerial.* (2) *With what wire and how many turns should the coils be wound.* (3) *What should the capacity of the condenser be.*

(1) No; another valve with H.F. amplification would be almost essential at such a distance. (2) The A.T.I. should be wound with about 6″×4″ of No. 24. The reaction 4″×3″ of No. 28. (3) The A.T.C. should be 0·0005 mfd. Use as small settings as possible. Blocking condenser 0·002 mfd.

**"WIRELESS FIEND" (Oundle)** *encloses particulars of a Reinartz tuner and asks* (1) *With regard to an aerial sketched would it be better to take the lead in from the middle or the end and bring it in over the rain gutter in an insulated tube.* (2) *Would the Reinartz Tuner and single valve detector described in the May issue receive* **LAW** *and* **2 KD** *and* **LQK** *at Huddersfield.*

(1) Take the down lead from the middle point of the level portion. (2) We have no information of the transmitting stations referred to.

**"S.J.C." (Wolverhampton)** *encloses a sketch of a circuit and asks* (1) *For criticism.* (2) *The wavelength range of set.* (3) *The capacity of condenser C.* (4) *For particulars of a telephone transformer, and if 0·0087 D.C.C. can be used for same.*

(1) The circuit is O.K. except that a condenser is needed across the primary of the telephone transformer. Also the reaction coil is unnecessarily large. (2) and (3) If C is 0·001 mfd. the range will be up to 6,000 metres. (4) The core should be ¼″ diameter. You can use 0·0087 D.C.C. for the L.R. winding. About 4 ozs. will be sufficient. The H.R. winding can be 2 ozs. of No. 42.

**"R.C.G." (Rogate)** *encloses a sketch of a wireless panel and asks* (1) *If the design is correct and the condenser values the best possible.* (2) *If the potentiometer is correctly connected.* (3) *Can a heterodyne be made to oscillate on all wavelengths by using different coils for tuning and reaction, and a tuning condenser of about 0·001 mfds., or if there should be a separate heterodyne for short and another for long waves.*

(1) The design is O.K. except that when, for instance, the closed circuit is plugged direct to the third valve, the grid winding of the H.F. transformer between the second and third valves should be broken or lost through this winding will be considerable. The same applies to the second valve. The grid condenser of the rectifying valve should not exceed 0·0003 mfds. except for very long waves. (2) Correct. (3) One heterodyne will do for all waves provided that a suitable collection of pairs of coils is made.

**"G.R. SHORT WAVE" (Annersley Woodhouse)** *asks how many tappings and how many turns between each tap will be needed on an inductance tube 4″×4″ primary, and 4″×3″ secondary, wound with No. 22 and No. 26 respectively.*

With good variable condensers in each circuit hardly any tappings will be required, while if no condensers, or only fixed value condensers are used, as many tappings as could be arranged would be needed. We should, of course, recommend the use of condensers, and you might then find it convenient to have about three equally spaced taps on each coil.

**"W.J.A." (Tottenham)** *asks questions about a single valve receiver.*

The coils will be quite suitable. Wind the primary of the loose coupler with No. 20 and the secondary with No. 22. If a secondary condenser of 0·0005 mfd. is used, the maximum wavelength will be about 6,000 metres. This value can be considerably increased by using a larger capacity with a parallel A.T.C. The reaction coil might be 8″×6″ of No. 22.

**"T.J.W." (Palmer's Green)** *asks how to design an inductance to give a required wavelength.*

The method is briefly as follows :—The formula $\lambda = 1885 \sqrt{LC}$ gives the relation between $LC$ for the wavelength required. In almost all detector circuits $C$ should be kept small, say 0·0005 mfds. Assuming this value $L$ can be worked out from the formula. When $L$ is found, suitable dimensions for the coil can be found by consulting the table on page 123 of Nottage's book, making allowance for the gauge of wire used, if necessary. Alternatively a guess at suitable windings can be made, and the inductance of the proposed coil worked out by a Nagoakas formula. The proposed dimensions can then be adjusted by trial until the computed value agrees with the value required.

**"R.F.F." (Oundle)** *asks* (1) *For a diagram of a tuner for a four-valve H.F. amplifier.* (2)

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*Could* **PCGG** *be received on a small indoor aerial stretched across the roof of a room with the same amplifier.*

(1) In Fig. 7, page 276, May 27th, you will find a combined tuner and amplifier. The tuning circuits alone may be used if you already possess the amplifier. (2) We think it is somewhat unlikely that very good results will be obtained, but it is worth trying.

**"SHORTY" (Portsmouth)** *asks for information regarding a proposed crystal set, range* 300/2,700 *metres.*

Wind the primary and the A.T.I. full of No. 20, and the closed circuit full of No. 28. The quantities required will be approximately, No. 20, 2 lbs, and No. 28, ½ lb.

**"NEW READER" (Streatham)** *asks* (1) *If* **2 MT** *could be received on a crystal set with an eight-wire aerial, and a range of* 500/3,500 *metres.* (2) *When a Broadcasting Concert begins, if call signs are sent out in Morse or verbally.* (3) *When do the official Broadcasting Concerts begin.*

If you can tune Marconi House your maximum must be less than 500 metres, as this station uses a wavelength of 360 metres. (1) No; you are unlikely to hear **2 MT**. (2) Service information in this case is given verbally. (3) No date is yet fixed.

**"MICRON" (South Shields)** *encloses a diagram of a set and asks* (1) *If L.F. transformers are likely to cause howling on long wavelengths.* (2) *With regard to certain figures concerning the construction of the A.T.I., if these are excessive.* (3) *If the H.T. and L.T. batteries should be joined in series or opposition.* (4) *If a grid condenser and leak are necessary for the H.F. amplifying valve, and what should be the value of blocking condenser across the transformer primary.*

(1) No, but the suggested circuit is O.K. It would be better to put the condenser on the aerial side of the A.T.I. (2) The suggested A.T.I. is O.K. Reaction coil is probably excessive. 25 millihys. should be sufficient. (3) It is almost immaterial provided that the positive of the H.T. goes to the plate of the valve. (4) It is not necessary with this arrangement. The blocking condenser may be 0·002 mfds.

**"G.H.B." (Warwick)** *encloses a sketch of his circuit and asks* (1) *If suitable for reception of concerts on an aerial* 45′ *long.* (2) *If* 0·00025 *mfds. is correct for the variable condenser C.*1 *and C.*2. (3) *If a tuning inductance of* 12″ × 3″ *wound with No.* 20 *D.C.C. and a reactance of* 10″ × 2¾″ *wound with No.* 20 *is suitable.*

(1) Yes: you will get Birmingham Broadcasting Station when it starts, but the set is not sensitive enough for the stations at present working. (2) The values are O.K., but C.2 need not be variable. (3) Yes, for short waves.

**"MORSE" (Hoylake)** *asks* (1) *With reference to a circuit described in the issue of April* 1*st page* 15, *why is the H.T. taken through the reaction coil before going through the primary of the L.F. transformer.* (2) *The advantage of putting a grid condenser and leak between the H.F. transformer and the grid of the second valve. Which are the better for short and medium wavelengths, H.F. transformers or reactance capacity couplings.* (3) *How to cut out the H.F. valve of a three-valve circuit by means of a double pole change-over switch.* (4) *Who are* **2 KW**, **2 GC** *and* **2 CV**.

(1) It is better to go straight to the reaction coil from the valve. (2) The use of a grid condenser and leak gives a somewhat more sensitive detector, but is liable to be a little more tricky in operation. Transformer amplification is the better for short waves, but is not adaptable to big ranges of wavelength without interchangeable transformers. (3) See diagram Fig. 1. (4) With regard to **2 KW**, see list of amateur transmitting stations published in our issue of July 1st. We have no knowledge of the other two stations mentioned.

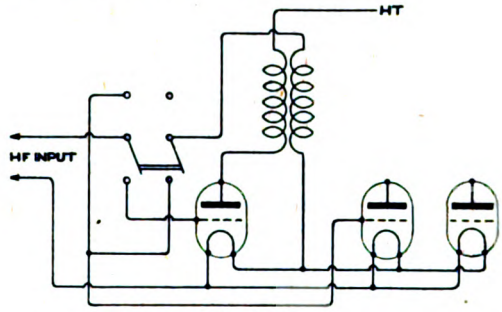


*Fig.* 1.

**"J.D." (S.E.18)** *asks for the formulæ which govern the capacities of the condensers described in the answers to* **"D.G.B." (Putney)** *and* **"G.G.F." (Newcastle).**

The correct formula is:—

$$C \text{ mfds} = \frac{1}{900{,}000} \times \frac{KAn}{4\pi d}$$

*K* being taken as approximately 8 for mica. This leads to the approximately correct results for **"D.G.B."** The value given to **"G.C.F."** is incorrect. The mistake, which we regret, is probably a printing error of 7 for 3, which would be approximately correct. It is impossible to predict such condensers accurately owing to the uncertainty of the di-electric constant of the mica used.

**"———" (Sutton Coldfield)** *asks* (1) *For particulars of set of basket coils to tune from* 150 *up to* 3,000 *metres.* (2) *For improvements to a circuit shown.* (3) *Gauge of a sample of wire.* (4) *If the auto-telephone transformer described on February 5th,* 1921, *will be suitable for* 300 *ohm telephones.*

(1) Wind about half a dozen coils for each circuit with a mean diameter of 3″, and from 40 to 350 turns. (2) Condensers should be used in series with the A.T.I. for short waves. (3) No. 40. (4) Yes.

**"W.L.B." (Walsall)** *asks* (1) *For windings for a set to tune from* 150 *to* 3,000 *metres with a* 0·001 *mfd. A.T.C.* (2) *Ditto for* 2,000/10,000 *metres.* (3) *Data for a L.F. transformer.*

(1) A parallel A.T.C. is very inefficient on short waves. Use it in series. A.T.I. might be 9″ × 6″ of No. 22 and reaction coil 5″ × 4″ of No. 28. (2) A.T.I. 9″ × 6″ of No. 28 with a parallel condenser. Reaction coil 7″ × 5″ of No. 32. (3) Core ¼″ diameter by 4″ long. Primary and secondary 1 oz. and 4 ozs. of No. 42.

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**"MAINDO" (Farnborough)** *asks* (1) *Whether a Reinartz Tuner or the tuner shown on page* 281, *June 7th issue, would be better for broadcasting reception.* (2) *If much modification would be necessary for the Dutch Concerts.* (3) *If any trouble would be experienced with re radiation with these sets.* (4) *For a winding for telephone transformer.*

(1) Either should be suitable, but we prefer the Reinartz. (2) The Reinartz could be brought up to this range with additional coils as described in the article. The exact dimensions for these coils should be found by experiment. Rumford's Tuner could also be brought up by increasing the size of the variometers. (3) Both these sets are liable to re-radiate. (4) H.R. winding 3 ozs. of No. 44, L.R. winding nearest the core 6 ozs of No. 30.

**"W.E." (Godalming)** *asks* (1) *Dimensions for a loose coupler with a range of from* 300 *to* 10,000 *metres.* (2) *If he should get* **2 MT** *and* **FL** *telephony on a single valve set.* (3) *Which is the nearest broadcasting station to him.* (4) *If he is allowed to use an aerial more than* 100 *ft. long.*

(1) One loose coupler would not be sufficient over so big a range. Use two, up to and above, say 2,000 metres. The latter might have primary $10'' \times 6''$ of No. 26, with a 0·001 mfd. parallel condenser and secondary $8'' \times 4\frac{1}{2}''$ of No. 30, also with a 0·001 mfd. condenser. Many figures for short wave couplers have been given recently. (2) Possible for a good set skilfully used, but results from **2 MT** will not be very strong. (3) London. (4) No.

**"W.E." (Newcastle)** *encloses sketch of circuit and asks* (1) *Will it receive telephony from European stations.* (2) *Consumption in watts of* 4*-volt Mullard valve filament.* (3) *Will a telephone induction coil function as a telephone transformer.* (4) *Does the H.T. negative come on to the positive or negative side of the filament of the valve.*

(1) From such stations as Eiffel Tower, yes. (2) If of normal receiving type, about 3 watts. (3) The resistance of the windings would probably make it quite unsuitable. (4) Generally immaterial.

**"SENNOCKE" (Sevenoaks)** *asks* (1) *Would an A.C. main lighting circuit interfere with the use of a single valve set.* (2) *Would a variable condenser as sketched be sufficiently variable.* (3) *Would the length of in-lead as sketch have any bad effect on reception.*

(1) No. (2) Yes, if you have a variometer or vernier condenser for fine tuning, but you will probably have considerable trouble with the contacts. (3) Yes.

**"B.V.W." (Sevenoaks)** *wishes to make a two-valve receiving set, diagram enclosed, and asks* (1) *If it will receive* **PCGG.** (2) *Winding data for the A.T.I. and reaction.* (3) *Can he use an "Ora" valve and a "V.24," or two "Ora" valves.* (4) *Number of plates required for a variable condenser for set of* 0·001 *mfd. capacity.*

(1) O.K., except that a blocking condenser should be used across the telephones, and a potentiometer for the first grid. (2) For such a large range a series of coils would be almost essential. We should recommend basket or honeycomb coils as advertised in this magazine. (3) Either arrangement is O.K. (4) You will require 105 plates in all.

**"REACTION" (Swansea)** *encloses particulars of set and asks* (1) *If connections are correct.* (2) *Why the telephones produce a high-pitched note when the slider of A.T.I. does not make contact with the A.T.I.* (3) *Can a valve be heard oscillating on the telephones.* (4) *Shortest and longest wavelength which can be received with set.*

(1) The connections and dimensions appear to be correct. We see no reason why you should not get good results. The A.T.C. should be variable. (2) Probably due to intermittent discharges across the bare contact or A.T.C. (3) Oscillation is not generally audible in your own telephones. If the set is oscillating a click will generally be heard on touching the aerial side of the A.T.C. (4) About 300 to 3,000 metres.

**"NOVICE" (Wellington)** *wishes to add a two-valve amplifier to his set, and asks for a diagram showing arrangement.*

See Fig. 7, page 216, May 13th issue, for an illustration showing how a combination of these two instruments could be effected.

**"G.V.F." (Beckenham)** *asks* (1) *Could he work a loud speaker on a single valve set.* (2) *Would results be good on an indoor aerial as sketched.* (3) *Lowest satisfactory capacities for two variable condensers as sketched.* (4) *Winding data for a tuning inductance.*

(1) Not satisfactory. (2) The results will be about the same as with a straight wire 12 ft. long, *i.e.*, not very good. (3) It depends on the wavelength range required. If not above 5,000 metres, not more than 0·0005 mfds. in either case. These condensers can be omitted if desired. (4) Wind full of No. 26. Reaction coil $5'' \times 3''$ of No. 30.

**"E.C." (Streatham)** *asks* (1) *Is the U.S.A. wire gauge the same as the British.* (2) *What sort of a valve panel can be used with a Mark III.* (3) *Would a Mark III with a valve panel be suitable for the proposed short wave broadcasting.*

(1) There is not a great deal of difference between the American and British gauges. The use of British No. 24 instead of American will not appreciably alter your wave ranges. (2) Any kind of valve panel can be attached thereto. The valve terminals go to the grid and filament of the valve. (3) This is not a particularly efficient arrangement as the valve is used merely as a detector and not as an amplifier. Various rearrangements of this tuner for more effective valve operation have been given in back numbers.

**"LAIREA" (Thorne)** *asks* (1) *If the tuner described in the issue of June* 3*rd, page* 281, *could be used with an indoor frame aerial.* (2) *If a frame aerial* 4 *ft. square could be used for broadcast reception.* (3) *If it is possible to add a note mag. valve to the circuit mentioned above.* (4) *Approximate broadcast range.*

(1) Yes, but efficiency would be considerably reduced. (2) Yes, if only a few turns were used. (3) Yes, in the ordinary way. (4) Probably about 50 miles with one valve.

**"N.W." (Swansea)** *has a single valve receiving set and asks* (1) *How he can remedy howling.* (2) *Particulars of windings.* (3) *Should the grid potential be positive or negative in his circuit.* (4) *Why his set does not function.*

(1) There appears to be too much reaction. Weaken this. Also try removing the grid condenser

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and using a potentiometer. (2) Using A.T.C. in series arrangement will require about 75 turns, and for the reaction coil about 60 turns on 2½" former. (N.B.—This circuit will give serious re-radiation.) (3) It depends on the type of valve, H.T. volts, etc. With the arrangement shown the potential required will generally be positive. (4) As you give no details as to the dimensions of your apparatus we cannot help you much, but try putting a variable condenser across the secondary. This will give you some chance of tuning the circuit. Do not use a grid condenser without a leak.

**"H.J.B." (Everton)** *asks* (1) *Winding to put on a solid wooden former of given dimensions for use as A.T.I.* (2) *If* 2,000 *ohm telephones could be converted to* 4,000 *ohms or higher.* (3) *If he could receive telephony in Liverpool on a crystal.* (4) *If his aerial is O.K.*

(1) A solid wood former will be very inefficient, wood being a very poor di-electric. As regards size, if you wind with No. 24, range would be up to about 2,000 metres. (2) This could be done by rewinding with finer wire, but we do not recommend it, as, unless you are very careful, you are not likely to improve the sensitivity. (3) Yes. Manchester broadcasting station and local amateurs. (4) O.K.

**"P.D.A." (Uppingham)** *asks* (1) *For criticism of circuit.* (2) *Dimensions for loading for his circuit.* (3) *Can "Ora" valves be used for this circuit.* (4) *What is the capacity of a condenser A in diagram, and should it be variable.*

(1) The circuit is O.K., except that amplification will be poor below about 1,000 metres. (2) 8" × 6" of No. 20 will probably be sufficient. (3) "Ora" valves will be suitable. (4) About 0·001 mfd. maximum capacity. It should certainly be variable.

**"S.B.X." (Liverpool)** *asks for three-valve and crystal circuit with loud speaker for reception of Manchester broadcasting.*

See diagram Fig. 2.

**"H.B." (Blackpool)** *asks* (1) *For a diagram of a three-valve circuit.* (2) *How many fixed and moving vanes would be required for a variable condenser to tune all wavelengths.* (3) *Voltage of H.T. and L.T. batteries.* (4) *Most suitable valves to use.*

(1) See Fig. 7, page 276, May 27th issue. (2) 21 fixed and 20 moving vanes, 3½" diameter, with a spacing of 1 mm. between fixed and moving vanes. (3) and (4) Any hard valve, for instance "V.24" or "R" type. L.T. voltage generally 6, H.T. 24 to 40 volts for "V.24" and "Ora" and 40 to 75 for "R" types.

**"R.A.J." (Woodside Park).**—Yes. Take the down lead from the middle of horizontal portion; also, if possible, stay away from the wall instead of leading it through a tube close to the wall.

**"NOR-RADIO" (Stavanger)** *asks* (1) *If he should receive* **LP, FL, 2 MT** *and* **PCGG** *on a four-valve set with an indoor aerial.* (2) *Why it is possible to obtain* **FL's** *carrier wave when his speech is inaudible with the reaction weakened.* (3) *What is the value of the modulation co-efficient.*

(1) **FL** and **LP**, possible; **PCGG**, possible; **2 MT** very unlikely. (2) Set is working in a more sensitive condition on the carrier wave, which is also intrinsically stronger. (3) We do not know the value employed in this station. Probably of the order of 50 per cent.

**"C.E.H." (Dewsbury)** *asks* (1) *What type of set to use to receive* **PCGG, 2 MT, FL** *and the proposed broadcasting stations.* (2) *What advantage* 8,000 *ohm telephones have over the* 4,000 *ohm type.*

(1) A four-valve set, with two H.F., one detector and one L.F. valve. The former are slightly more sensitive than the latter.

**"J.L." (Newcastle-on-Tyne)** *asks* (1) *For criticism of a set.* (2) *If suitable for telephony, including* **PCGG.** (3) *How to fit another valve as L.F. magnifier.* (4) *If slab coil or a loose coupler (presumably solenoid) would give better results.*

(1) O.K. if a fixed condenser is put across the winding of the first L.F. inter-valve transformer, which is in series with the reaction coil. (2) Yes. (3) Fit exactly as your present third valve, the input side of your additional L.F. transformer being inserted in place of the telephones. (4) This depends mainly on the wavelength, slab coils being more convenient for long waves and solenoids more efficient on the short to medium waves.

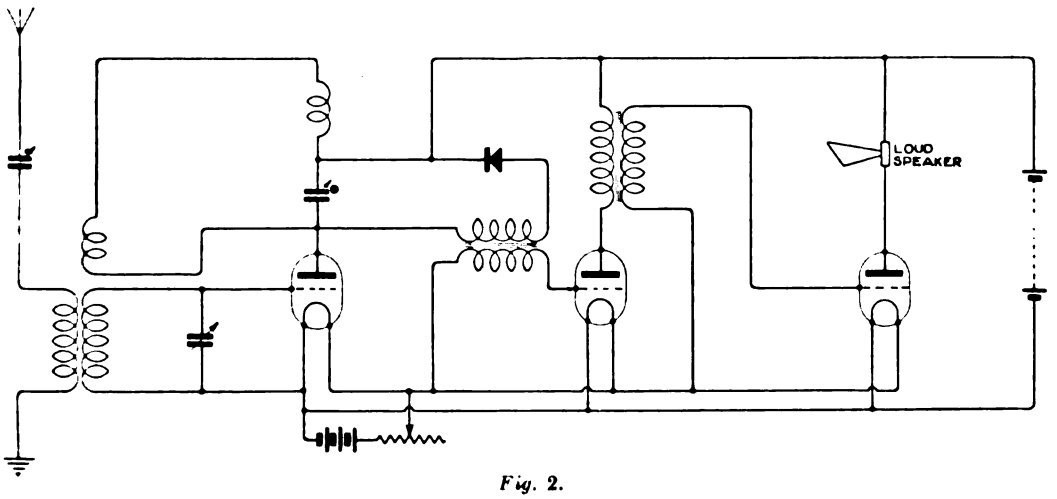


*Fig. 2.*

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**"E.A.F.B." (Westcliff-on-Sea)** *asks* (1) *For a diagram of a three-valve set to receive amateur broadcasting,* **PCGG** *and other telephony.* (2) *How he can get* **PCGG** *on the set described.* (3) *Would pin type H.F. transformers be a great improvement over resistance coupling.* (4) *Is a fourth valve as note magnifier necessary to get* **PCGG.**

(1) and (2) Your present set should meet the case. The only fault appears to be the absence of a condenser across the anode winding of the L.F. transformer. You might add a potentiometer to the first grid. (3) Transformer coupling would be better for the broadcasting band. (4) It certainly should not be.

**"A.G." (Hanley)** *asks* (1) *For details of minimum apparatus necessary to receive broadcasting and other telephony from a distance of* 150 *miles.* (2) *Details of minimum apparatus for receiving broadcasting telephony from Birmingham and Manchester.* (3) *How to connect up the instruments.* (4) *Would the P.M.G. grant a licence for home-made wireless set.*

(1) and (2) Seeing that the Birmingham and Manchester Stations will be so much nearer to you and will give services almost identical with London, you will be well advised to try for them alone first, as really good results at 150 miles will need a good set skilfully used. For Birmingham and Manchester a single valve set will do. If you know nothing about the subject we should advise buying the complete set or else getting a text-book and studying the whole subject before making your own set. It is impossible in any case to state minimum apparatus required as the nature and locality will affect it as well as the quality of the results required. (3) One of many possible circuits is shown in Fig. 1, page 243, May 20th. (4) Yes, but the cost of the licence will be considerably more than for a special broadcast receiver of a type approved for the purpose by the G.P.O.

**"EXPERIMENTER" (Crouch End)** *asks for dimensions for an inductance unit to oscillate at* 600 *metres in a circuit sketched.*

The use of an inductance alone without a condenser for this purpose is practically impossible unless the coil is calibrated against standard wavelengths, as minute differences in the covering of the wire and the windings would create such serious differences in the resultant wavelength used in this way that it would be out of the question to attempt to predict the correct size for the coil.

**"E.V." (Wattsville)** *asks* (1) *Will a frame aerial as shown in diagram connected to a crystal receiving set give any strength of signals.* (2) *To what apparatus is the aerial end of the frame aerial connected.* (3) *Would a simple silicon detector and inductance connected to this frame aerial receive spark signals of* 200 *miles radius.* (4) *Would the aerial wire, passing through the holes in the frame, require to be insulated.*

(1) No. (2) The ends of the frame winding should be connected across a variable condenser, which should itself be across the grid and filament of the valve. The aerial will practically be of no use with a crystal set however arranged. (3) No. (4) Preferably—with any normal wireless insulating material, e.g., ebonite.

**"N.B." (Sowerby Bridge)** *encloses diagram of his four-valve circuit from which he gets very poor results, and asks* (1) *Is it correctly wound.* (2) *Would transformer coupled be better than impedance coil for the H.F. valves.* (3) *Are the 2 megohm leaks and Mullard "Ora" valves satisfactory.* (4) *Will the set be efficient on short waves.*

(1) Your aerial circuit is all wrong, as it shows the set with nothing connected to earth when on tune side and with the grid of the first valve earthed when on stand-bi. Moreover, 300 megohms is far too high for a potentiometer resistance. You probably mean 300 ohms. (2) There should be very little difference at 1,000 metres. (3) They should be O.K. Your condenser or valve panel seems to be very leaky. (4) The set will not be very efficient below 100 metres.

**"RADIO" (Salford)** *refers to the crystal set, Fig.* 2, *page* 120, *April* 22*nd issue, and asks* (1) *Is it suitable for local broadcasting.* (2) *Size of coil and wire required and capacity of condenser for wavelengths from* 200/3,000 *metres.*

(1) Certainly, within a distance of about 12 miles from a broadcasting station. (2) A.T.I. $9'' \times 6''$ wound with No. 22. Coupling coil, $3'' \times 3''$ of No. 22, with one or two tappings. Closed circuit inductance, $6'' \times 4''$ of No. 26, with about six tappings. Variable condenser 0·0005 mfds.

**"HENRY" (Hampstead)** *asks re the tuner of a single valve circuit. Range about* 300 *to* 5,000 *metres.* (1) *The dimensions of solenoidal A.T.I. and number of tappings, and range of small suitable variable condenser to be used in parallel.* (2) *Dimensions of solenoidal reactance.* (3) *Stations likely to be received by the set.*

(1) $9'' \times 6''$ wound with No. 24, tapped at 1", $1\frac{1}{4}$", $2\frac{1}{4}$", $3\frac{1}{4}$", 5" and 7". The condenser should be about 0·0005 mfds. approximately, and should be in series at the shorter wavelength. (2) Reactance $5'' \times 4''$, wound with No. 28 or 30, and tapped at every inch. (3) London Broadcasting Stations, **2 MT,** Air Stations, Ships and Continental Stations such as Norddeich, Eiffel Tower, etc.

**"L.O." (Hampstead),** *with reference to the short wave set described in the "Work" book by E. Redpath, Esq., asks* (1) *What difference, if any, will it make if formers of* $3\frac{1}{2}'' \times 4\frac{1}{8}''$ *are used instead of those given.* (2) *Should the leads from secondary tappings be kept inside the secondary former and led out through one of the end plugs to the panel studs.* (3) *Will it be possible to hear the London Broadcasting Stations on a crystal set.*

(1) The set will tune to higher wavelengths, but not to as low a wavelength as the original. (2) It will be best to take the leads along the inside of the secondary to the end plug. This can easily be done while the coil is being wound, but not afterwards. (3) Certainly.

**"VICTORIA" (Stranraer)** *asks* (1) *If the telephone set described in Fig.* 1, *page* 316, *in the issue of July* 24*th,* 1920, *would have a range of* 5 *or* 6 *miles.* (2) *If the set in question* (1) *is not suitable, for a diagram of suitable set.* (3) *If it is better to use set as sketched or with aerial and earth inductively coupled.*

(1) Quite suitable. The microphone may be shunted across part of the A.T.I. or connected in series with it. (3) There is no necessity to couple inductively a set of this type.

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"**SAILOR**" **(Dover)** *asks* (1) *How to add a valve to a circuit sketched.* (2) *Could he use slab inductances in place of a loose coupler.* (3) *Wavelength range of a certain coil.* (4) *Could a 6-volt accumulator be used for "Ora" valve.*

(1) See diagram Fig. 3. (2) Slab coils could

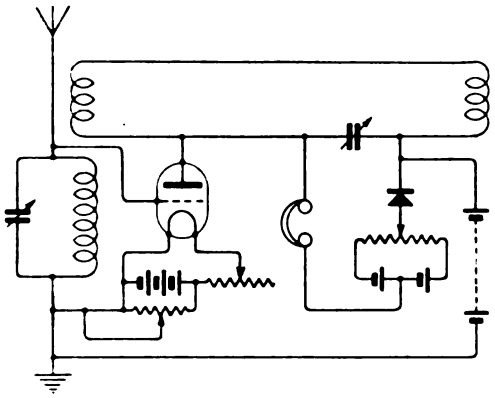

*Fig.* 3.

be used. Except for very short wavelengths the reaction coil should be smaller than the A.T.I. (3) About 2,800 metres. (4) O.K.

"**X.B.S.**" **(Yorkshire)** *asks* (1) *If the Reinartz tuner described in the issue of May 31st is suitable for S.W. telephony.* (2) *If tubular condensers would be efficient for telephony.* (3) *What size of condensers to use with Reinartz tuner.* (4) *If a separate licence is required for a portable set, and if the area over which it may be used is limited.*

(1) Yes, if carefully used to prevent re-radiation. (2) Quite satisfactory. (3) Both 0·0005 mfd. (4) Separate licence is usually required, but why not write to the Secretary of the Post Office?

"———" **(Widnes).**—Range of your set will be up to about 3,000 metres. A variable condenser for series use and short wavelengths would be an improvement. A potentiometer is not necessary.

"**J.W.K.**" **(Stanmore)** *encloses diagram of three-valve transformer circuit and asks* (1) *If it would be suitable for all telephony.* (2) *Data for constructing transformers, inductances and condensers.* (3) *Data for the construction of fixed condensers of 0·00025 mfd. and 0·0004 mfd.* (3) *Would the set described on page 280 of the May issue be suitable for telephony; if not, what additions would be required, and would it interfere with other people.*

(1) The circuit is O.K. A.T.I., 9″×6″ of No. 22; Secondary inductance, 6″×4″ of No. 28; A.T.C., 0·001 mfd.; C.2, 0·0005 mfd.; C.3, 0·0002 mfd.; C.4, 0·001 mfd. (2) Condenser should be 0·00025 mfd., mica 4 mils thick, four foils overlapping 2 cms. × ½ cm. For second condenser 0·0004 mfd., as above, but six foils. (3) We do not think so.

"**RAFAT**" **(Hull)** *asks for a diagram of a three-valve circuit for all wavelengths between 400 and 24,000 metres.*

See Fig. 3, page 340, issue June 10th. In order to cover such a large range of wavelengths it will, however, be necessary to use a series of H.F. interchangeable transformers, about six being needed for each pair of valves.

"**A.H.**" **(Sheffield)** *asks* (1) *Would* **PCGG, 2MT** *and* **FL** *telephony be audible at Sheffield on a three-valve receiver with a frame aerial.* (2) *If some wires 10 ft. long, stretched across a room, would be better.* (3) *How many and what distance apart would the wires require to be.* (4) *Suggestions for a better arrangement of aerial.*

(1) No, you should use at least two stages of H.F. amplification. (2) This is somewhat better than the suggested frame. (3) Only two or three, say 2 ft. apart, would be required. Make the down-lead as long as possible. (4) An indoor aerial with four or five valves, including two H.F., should give the required results.

"**E.D.**" **(Kennington)** *asks* (1) *For diagram of a panel to be connected to one already in use.* (2) *If necessary to have separate H.T. batteries for soft and hard valves.* (3) *If it is necessary to use L.R. telephones with a transformer.*

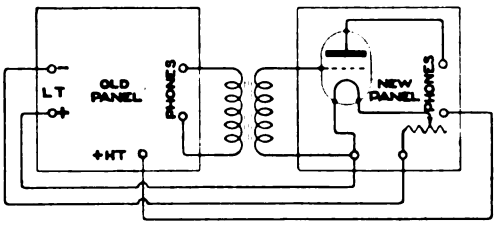


*Fig.* 4.

(1) See diagram Fig. 4. (2) If the valves are of such widely different types we should recommend separate H.T. batteries and filament resistance, although the second H.T. battery could very likely be dispensed with. (3) The H.R. telephones will be quite suitable.

"**K.B.**" **(Hucknall)** *sends diagram of a set and asks* (1) *If the connections are correct.* (2) *Winding data for the inductance.* (3) *If it will be possible to receive telephony from a distance of 150 miles.* (4) *Would a two-valve set be better.*

(1) The connections are O.K. if the negatives of the two batteries are connected together as well as to the earth. (2) For British broadcasting, 80 ft. of No. 22 for the A.T.I., and 50 ft. of No. 26 for the reaction. (3) You are unlikely to get such a range—50 ft. is more like it. (4) Certainly; see Fig. 2, page 272, May 27th, and many others.

"**CRYSTAL**" **(Elland)** *has a set which works well except on telephony. He asks* (1) *How to improve it.* (2) *If variable H.F. transformers would be better than resistance capacity coupling.* (3) *If* **PCGG** *should be heard with four valves.* (4) *Causes of noises in telephones if the L.F. valves are too bright.*

(1) If a set works well on everything else it must be suitable for telephony. Failure is probably due to unskilful handling. For good results very careful reaction adjustment is required. A potentiometer is not required. (2) Very little difference at 1,000 metres. Transformer coupling better on short waves. (3) Yes, but more H.F. amplification instead of L.F. would be better. (4) Due either to

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an uneven discharge of the battery at the high rate or to accentuation of noises already there owing to a steepening up of the characteristic.

**"LABURNUM" (Bethnal Green)** *asks* (1) *The wavelength range of a certain circuit.* (2) *If* 0·0003 *mfd. is too small a condenser for a closed circuit.* (3) *If a certain winding will be suitable for a spherical reaction coil.* (4) *What times are indicated by* 15.50 *and* 23.30 *G.M.T., and if there is a code book for deciphering these times.*

(1) Approximately 3,500 metres. (2) No. The parallel vernier condenser you suggest would not greatly affect the wavelength. (3) No. Wind it with the same wire as the coil in (1). (4) 3.50 p.m. and 11.30 p.m., G.M.T., *i.e.*, 4.50 p.m. and 12.30 a.m., B.S.M. No code book is necessary. The last two figures give the minutes and the first one or two the hours, reckoning 24 from midnight to midnight.

**"R.G.W." (Stockton-on-Tees).**—(1) If you are using reaction you should hear **PCGG, 2 MT** and **FL**, all weak. Without reaction we doubt if you will get much except local amateurs. (2) We should prefer the new H.F. panel, but the alternative scheme should give quite good results if properly designed. (3) A.T.I., 9″ × 6″ of No. 22, with slider. Coupler primary, 3″ × 3″ of No. 22, two taps. Coupler secondary, 6″ × 5″ of No. 26, six taps. Reaction coil, 4″ × 3″ of No. 28, three taps. (4) Use the same gauges as in (3), and try the following numbers of turns; the cams used do not matter much :—

| Metres | A.T.I. | Closed circuit | Reaction |
|---|---|---|---|
| 200 - 600 | 120 | 100 | 50 |
| 600 - 1,200 | 200 | 200 | 120 |
| 1,000 - 4,000 | 350 | 350 | 200 |

Final adjustment should be made by experiment.

**"M.E.M." (Clayton)** *asks* (1) *For criticism of a set.* (2) *For criticism of a suggested intervalve transformer.* (3) *If fine tissue paper may be introduced between the layers of the windings.* (4) *How to make honeycomb coils.*

(1) Circuit O.K., but grid condenser should be about 0·0002 mfd. With vanes 4″ diameter and spacing 1 mm. between fixed and moving, 16 plates will be required of 0·0005 mfd. and 31 for 0·001 mfd. (2) Probably O.K., although 4/1 is rather a high ration of turns. (3) Yes. (4) These coils need some form of winder, such as the "Lokap," or the winder described in the issue of July 3rd, 1921. The use of such coils will enable a range to be brought up to any desired value.

**"E.O." (Leyton)** *wishes to transmit about* 50 *yards and asks if it would be possible to do this with, for instance, a coherer set without the necessity of a transmitting licence. Also, if reception on a crystal would be possible.*

Transmission without licence is only allowed in the case of what may be called toy sets. We do not know of any ruling as to the exact range which may be covered. We should advise application to the P.M.G. for a ruling in regard to your case. Crystal reception could be employed, but not very easily, with the type of set generally used for these transmitters, which operate on a very low wavelength.

**"L.J.R." (St. John's Wood)** *asks* (1) *Question about certain aerials.* (2) *For dimensions for a* 0·0005 *mfd. condenser.* (3) *Dimensions for a* 0·002 *mfd. variable condenser.* (4) *If* 120 *ohm. telephones can be used with a crystal set without a transformer.*

(1) The aerial across the road would give better results, and would not affect the other stations, but it would be necessary to obtain a permit from the authority responsible for the road. This might be somewhat difficult to obtain. (2) About 30 plates, with a space between fixed and moving of 1 mm., diameter of plates 3″. (3) 45 plates, 5″ diameter, also with a spacing of 1 mm. (4) A transformer must be used.

**"H.R." (York).**—(1) and (2) Set should give **PCGG** if the parallel A.T.C. is removed, or only used at approximate minimum value. Also, grid condenser should be about 0·0002 mfd. and not 0·004 mfd. (3) The H.R. telephones will be somewhat more sensitive than the L.R. and transformer

**"L.H.C." (Cambridge)** *asks which of the formulae* (*a*) $\lambda = 1885\sqrt{LC}$ (*b*) $\lambda = 597\sqrt{LC}$ *is correct where* $\lambda$ = *wavelength in metres, L is inductance in mhys., and C capacity in mfds.* (2) *If a combined crystal and valve set is suitable for* **PCGG.**

(1) Formula (*a*) is correct formula; (*b*) is correct if inductance is measured in mhys., and capacity in millimicrofarads.

**"S.W.R." (London)** (1) Wind primary with No. 26, and reaction coil with No. 30. (2) About two equally spaced taps on each coil. (3) No. 26. (4) See diagram Fig. 6, page 94, April 15th issue.

**"C.G." (Lowestoft).**—(1) Your present set is of very inefficient type. Revised set should be as in Fig. 5, page 92, April 15th issue. (2) An iron-cored L.F. with a valve transformer is required. This should have a core ½″ in diameter, with windings of 1 oz. and 3 ozs. of No. 42. (3) Not essential, but generally desirable.

**"INTERESTED" (Eastbourne).**—(1) Yes. (2) Yes. about 0·002 mfd. (3) 0·0005 mfds. (4) Yes. Certain extra parts would be required, but all the old apparatus could still be employed.

**"TRIER" (Manchester)** *wishes to use a two-valve set with an indoor aerial, and asks what resistance telephones to use, and if a suitable telephone transformer has been described.*

The suggested aerial is very poor. You will get as good result from about 25′ of wire in a straight line somewhere in the house. Telephones may be 4,000 ohms, or 120 ohms with transformer. For transformer see article on page 782, February 5th, 1921, issue.

## SHARE MARKET REPORT

Prices as we go to press on June 30th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 4 | 6 |
| ,, Preference .. .. | 2 | 0 | 6 |
| ,, Inter. Marine.. .. | 1 | 7 | 3 |
| ,, Canadian .. .. | | 9 | 3 |

Radio Corporation of America :—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | | 19 | 6 |
| Preference .. .. .. | | 14 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 17. JULY 22ND, 1922 WEEKLY

# A Further Development of the Armstrong Circuit.

## HOW TO APPLY THE PRINCIPLE TO EXISTING APPARATUS.

By EDGAR H. FELIX, Associate I.R.E.

SUPER-REGENERATION is the term used in description of the new circuit recently described by E. H. Armstrong. In utility it overshadows previous achievements of its discoverer.

Armstrong is responsible for the development of the regenerative principle in its application to heterodyning by means of which we amplify short wave signals at radio frequencies to an extraordinary degree.

The super-heterodyne was used last December by the American observer in receiving amateur signals from the United States. Two hundred feet from his head-phones he could easily hear the signals from one of the American amateur stations.*

Now, if the super-regenerative circuit is used, such results are possible with but *two* vacuum tubes instead of ten. With its use the radio frequency transformer becomes unnecessary. With this circuit it is claimed that the only limit to the amplification obtainable for any signals is the tube's current carrying capacity.

### LIMITATIONS OF THE REGENERATIVE CIRCUIT.

If you operate a regenerative receiver, you have noticed that there is a definite limit to the amplification of music by means of regeneration. Too much reaction coupling causes the receiver to generate continuous oscillations. When it does this, the good tone quality of the music received is lost.

Armstrong's new discovery is a method by which we can make full use of reaction without causing the receiver to generate oscillations.

The reaction may be considered as the insertion of "negative resistance" in the vacuum tube circuits. Such resistance wipes out the positive resistance of the tube and its associated circuits or tends to do so. When the negative resistance applied by reaction approaches a certain relation to the positive resistance—let us say when the negative and positive resistances are approximately equal—the receiver generates continuous oscillations.

Immediately before this point of approximate equality is reached there is, however, considerable amplification of music without distortion. For five or six years, many have exclaimed to themselves: "If only the negative resistance could be made greater than the positive without having the undesirable oscillations set up, what tremendous amplification would be possible!"

It seems obvious that the theoretical limit of amplification is reached when the positive resistance approaches and approximately equals the negative resistance. Certainly, it was

* *This refers to the station* 1BCG.—Ed.

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argued, the system will oscillate if the negative resistance becomes greater than the positive.

Armstrong set out to solve the seemingly impossible problem—and he has succeeded.

Armstrong's home station uses a small loop antenna and two vacuum tubes connected up with his super-regenerative system. WJZ is twenty miles away. Yet, 1,500 feet from his phones, Armstrong can hear the music sent by WJZ.

For illustration, imagine first an alternator generating a current of fifty thousand cycles or more—in fact any frequency beyond audibility. Next, imagine such an alternator coupled with the plate circuit of an ordinary regenerative receiver. If the apparatus could be adjusted so (1) that the maximum regeneration would take place when the alternator is positive and (2) so that regeneration would be prevented when the alternator is negative, you would

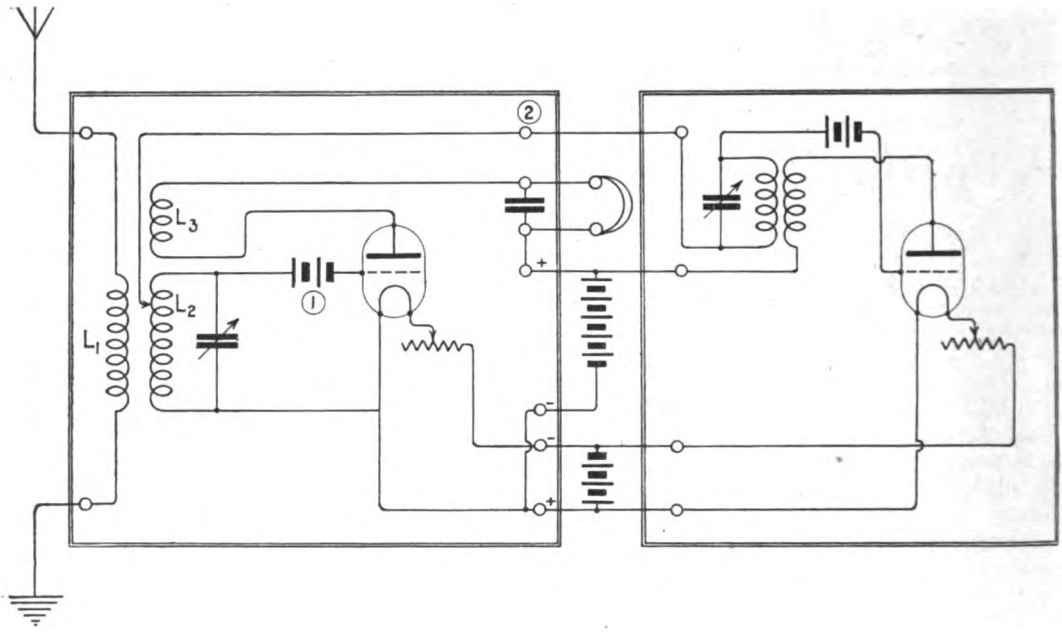


*Fig* 1. *The Super-Regenerative Circuit, adapted to a reaction receiver for reception of telephony. Changes required in the receiver are :* (1) *Substitution of battery to give a negative potential in the grid for grid condenser and grid leak ; and* (2) *tap connected to top of secondary inductance.*

At a recent meeting of the Institute of Radio Engineers, at which Armstrong first publicly described his invention, a small loop receiver was set up. With a regenerative circuit and two steps of audio-frequency amplification, music from WJZ could barely be heard even when the phones were but a few inches from our ears. This is due to the fact that the Engineering building is a steel structure and so well shielded that it is almost impervious to radio signals.

But with Armstrong's three-tube super-generative circuit, we could easily hear the music in every part of the lecture hall !

HOW SUPER-REGENERATION WORKS

The basic principle of super-regeneration is very simple.

have something that would meet the case. In such a case regeneration would not destroy the quality of music, for it would be choked so frequently and so rapidly by the alternator that the musical qualities would be retained; and in addition, full advantage would be obtained from the regenerative effect which would build up during the positive period of the alternator's cycle.

The same result would be obtained were the alternator coupled with the grid circuit or with the secondary circuit.

The most satisfactory generator of continuous waves of high frequency is of course the vacuum tube associated with the proper circuits. Armstrong therefore evolved circuits employing the vacuum tube as the generator of the

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high frequency oscillations. One tube serves the ordinary function of detector and regenerator; the other serves as oscillator, producing high frequency current which is impressed upon one of the circuits of the first tube in such a way that the negative resistance exceeds the positive resistance at intervals of 1 50,000 of a second or less.

SUPER-REGENERATION FOR RADIO-TELEPHONY.

Figure 1 shows the circuit best adapted to reception of radio-telephony. The section enclosed in the box on the left shows an ordinary reaction receiver, modified only by the substitution of a grid battery and a tap at the top of the secondary of the vario-coupler. $L_1$ and $L_2$ are the primary and secondary of the tuning circuits; $L_3$ is the reaction coil.

The second tube and its circuits comprise the oscillator. The grid and plate circuits are coupled by inductances $L_4$ and $L_5$. The grid inductance is shunted by the variable condenser which determines the frequency of the oscillations generated. The output of the oscillator tube is impressed on the secondary of the receiving transformer or vario-coupler.

When the oscillator tube is conductive, it short circuits the secondary, stopping for the moment the generation of oscillations. When the charge on the grid of the oscillator tube reverses, the first tube oscillates. The oscillator tube therefore acts as a switch, short circuiting the secondary 50,000 times per second or more.

HOW TO ADAPT SUPER-REGENERATION TO A REACTION RECEIVER.

This circuit is drawn so that from it you can make a super-regenerative unit to add to your regenerative set, thus converting it into a super-regenerative receiver.

Figure 2 shows a circuit particularly adapted to C.W. reception. It employs a third tube which acts as detector. A separate inductance coupled to the secondary is used to transfer the output of the oscillator tubes to the detector tube. The heterodyned frequency is controlled by the variable condenser across the inductance in the plate circuit of the first tube and by the variable condenser across the grid inductance of the second tube. In this circuit the oscillator tube acts upon the positive resistance of the plate circuit.

The third circuit acts upon both the grid and plate circuits of the first tube, reducing the negative resistance while increasing the positive, and vice versa. This circuit gives the greatest amplification possible with two tubes. It will appeal to amateurs wishing to make the most of their equipment, even at the expense of greatly increased number and difficulty of adjustments.

ADJUSTING THE SUPER-REGENERATIVE CIRCUIT.

The process of adjusting these circuits after they are set up is as follows.

First, the coupling of the oscillator tube is reduced to a minimum, so that no oscillations are generated by the oscillator tube.

Second, the antenna and secondary circuits are tuned in the usual manner.

Third, the reaction is adjusted until maximum amplification without distortion takes place.

Fourth, the coupling of the oscillator tube

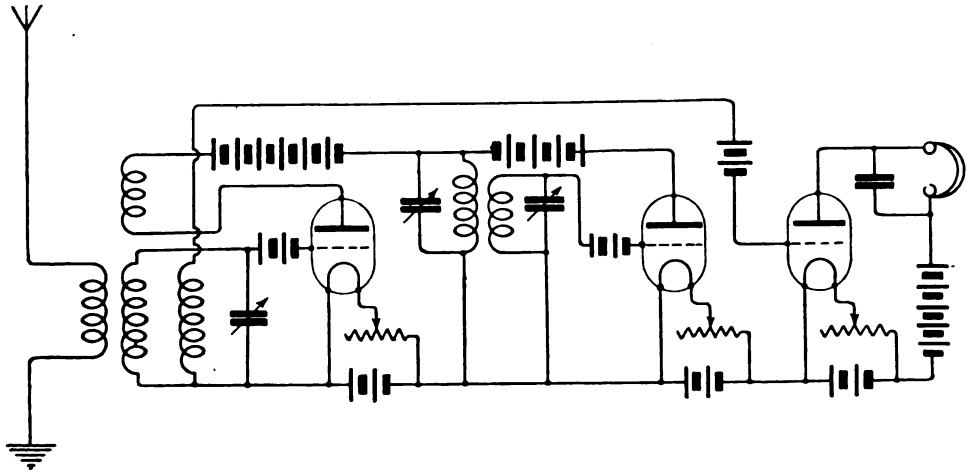

*Fig. 2. The Super-Regenerative Circuit adapted to C.W. reception. The third valve acts as a detector of the combined outputs of the oscillator and amplifier valves.*

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circuits is increased until one hears the familiar click which indicates that continuous oscillations are passing through the phones.

Fifth, the reaction coupling of the first tube is increased

Sixth, the variable condensers of the oscillator tube circuits are readjusted until the quality of the music is restored.

REDUCTION OF SPARK STATION INTERFERENCE.

In addition to possessing extraordinary amplification properties, the super-regenerative system greatly reduces interference from

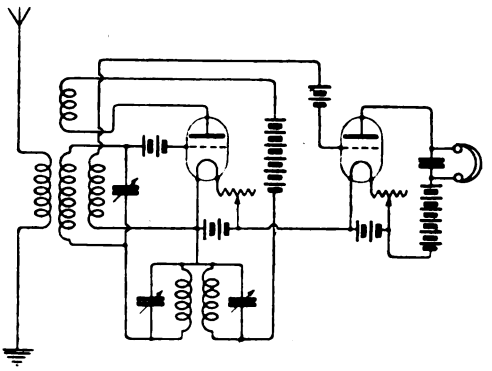

*Fig. 3. The Super-Regenerative Circuit, by means of which both negative and positive resistance is acted upon. The second valve acts merely as a detector.*

spark stations. With ordinary reaction, the trouble from spark stations is much increased because their interfering signals are maintained after the incoming energy from the spark station has ceased.

With the super-regenerative circuit, regenerative action is periodically damped out tens of thousands of times per second, so that the interfering spark signal is stopped as soon as it ceases affecting the receiving antenna.

The super-regenerative system requires "hard" valves.

A remarkable feature of the super-regenerative circuit is that its amplifying power increases inversely as the square of the wavelength. This means that the shorter the wavelength the greater the amplification. In this way the problem of interference is greatly minimised, for the shorter the wavelength the smaller the band of wavelengths affected by one transmitter.

Cascade amplification is possible with the system, but with entirely new methods and circuits. Audio-frequency amplification, as we are familiar with it, sets up harmonics, rendering the system inoperative. This difficulty is overcome by applying audio-frequency amplification to the second harmonic of the station whose signals it is desired to amplify.

Within a short time many amateurs will have supergenerative sets in use, and no doubt simple variations and applications of the system will be evolved. This article attempts merely to make sufficient information available to enable the amateur to begin his experiments. Much interesting information is left for the future.

# A Four-Valve Station Suitable for Short Wavelengths *(continued).*

By PERCY W. HARRIS.

2.—THE HIGH-FREQUENCY AMPLIFIER AND DETECTOR UNIT.

IN the last article the tuner for this station was described. This, as mentioned, is the first of three units. The second is a two-valve high-frequency and detector unit which can be used by itself or in combination with a two-valve low-frequency amplifier to be described in a further article.

For short wavelengths the resistance-capacity method of high-frequency amplification is ruled out, and one must have recourse to either transformer or reactance-capacity coupling. When it is not desired to receive wavelengths much below 600 metres, tapped transformers and reactance coils prove very satisfactory, one method of using such having been described by the present writer in *The Wireless World and Radio Review*.*

The particular receiver described in this article has been tested down to 140 metres and has been found very efficient. The circuit used is that described before the Wireless

* *Wireless World and Radio Review*, April 1 & 8, 1922

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Society of London by Mr. Frank Phillips.† This uses reactance-capacity coupling, the reactance coils being interchangeable. One set of coils can be used for both tuner and amplifier, as the coil used in the amplifier is always larger than that used in the tuner. The chief feature of this particular circuit apart from its efficiency is its stability, which is obtained by connecting the grid of the H.F. valve to the *positive* filament terminal, thereby maintaining the grid at positive potential and stopping all tendency to self-oscillation. The loss of efficiency due to positive grid potential is made up by the reaction coil which supplies from the H.T. battery the energy otherwise lost. Unless the grid is so connected it is necessary to use a potentiometer to control grid potential, and this introduces a complication and further adjustment (although in some cases a slightly higher efficiency may be obtained).

In considering the construction of such a receiver, the writer thought it advisable not to incorporate the reactance tuning condenser in the instrument, as condensers are very useful in experimental work, and few experimenters wish to reserve a good variable condenser for one purpose alone. Terminals are therefore fitted for the connection of an external condenser, which may be of a value to suit the particular range of waves being received. In most cases a maximum of 0·0001 mfd. is the largest advisable.

Fig. 1 shows the general appearance of the

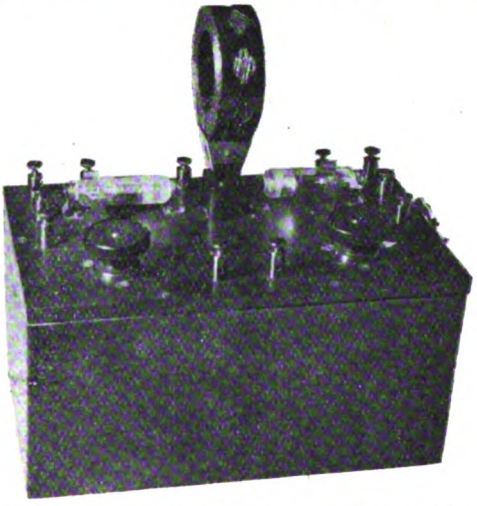

*Fig. 1. General appearance of the H.F. amplifier and detector unit.*

†*Wireless World and Radio Review*, April 8, 1922.

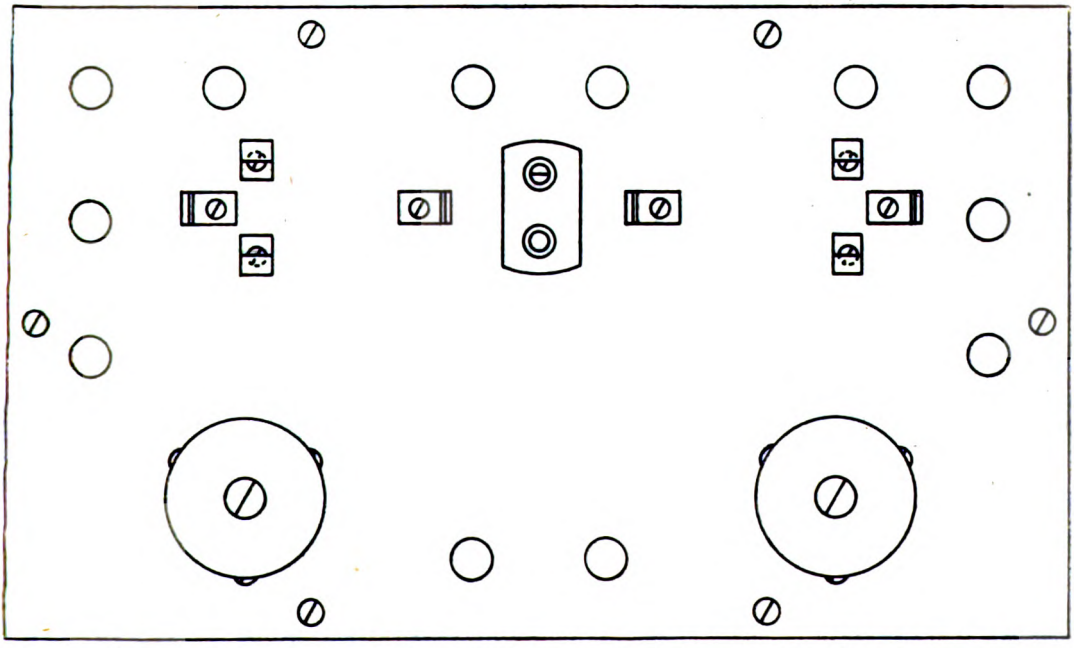

*Fig. 2. Layout of Panel. Terminals on the left are for "Input." On the top row they are for reaction, reactance condenser, and H.T. respectively; the pair on the right side being for L.T., and those at the front for telephones or note magnifier unit.*

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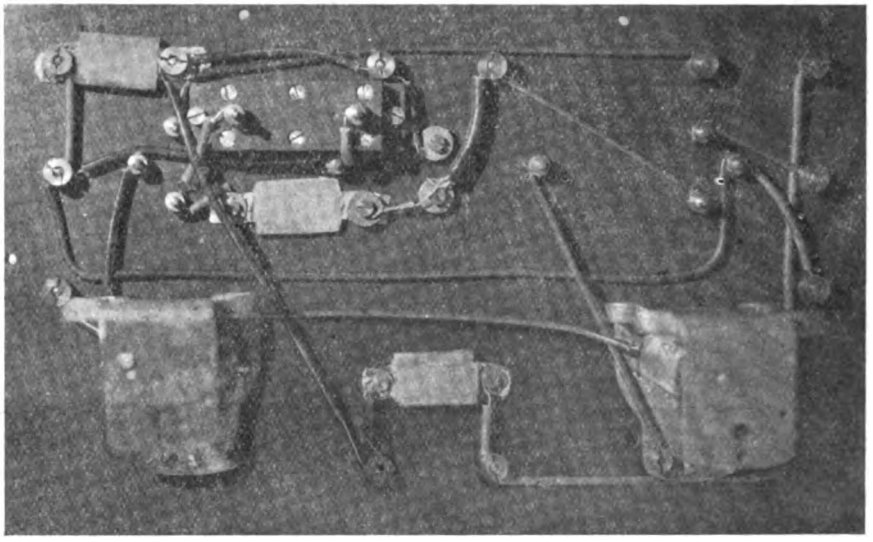

*Fig. 3. The underside of the panel, showing the wiring connections.*

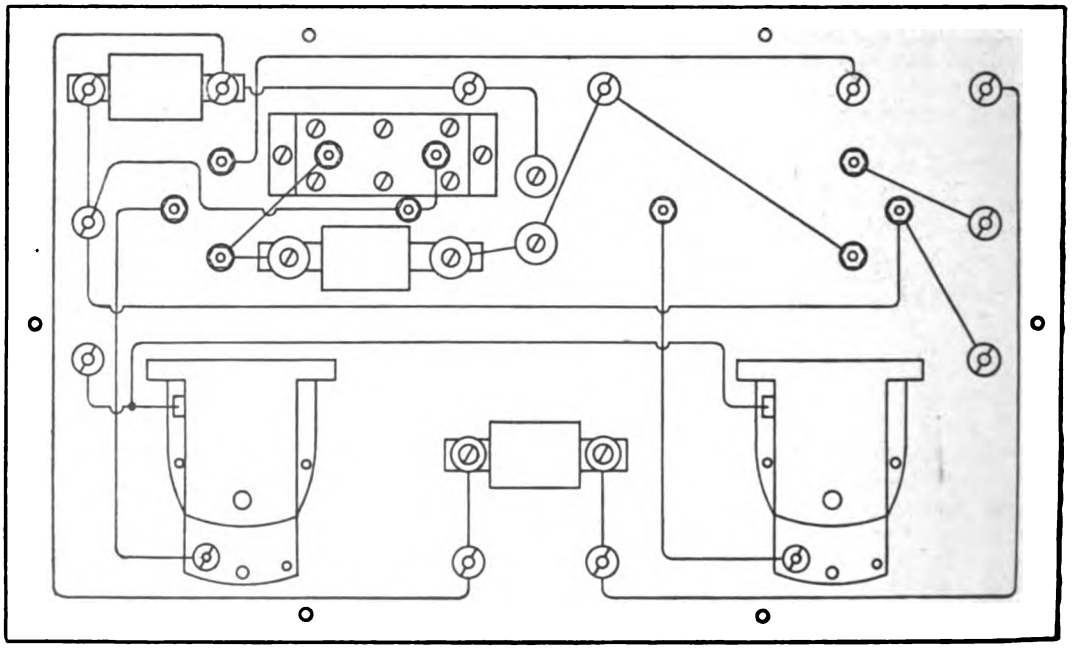

*Fig. 4. Layout of underside. The ordinary type of filament resistance can be substituted for the special type shown here.*

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instrument. It is designed to use V24 or QX valves, as these are particularly efficient on short wavelengths, owing to their small internal capacity. Obviously the four-pin type of valve could be used with slight modification of the design.

A separate filament rheostat is fitted for each valve, as the purpose of the two valves is different, and separate adjustment is necessary to obtain best results. There are twelve terminals on the instrument, for "Input," "Reaction," "Tuning Condenser," "H.T.," "L.T." and "Output" respectively. The plug-socket for the interchangable coils is placed between the two sets of valve clips, and immediately adjacent are the terminals for the reactance tuning condenser. In this way the leads to the condenser are kept short.

CONSTRUCTIONAL DETAILS.

The box is made as described in the last article, and measures 10 ins. by 6 ins. by 5 ins. deep. As the box for the two-valve note magnifier is of the same dimensions, both may be made at the same time. They can be finished with two coats of mahogany varnish stain, if made of ordinary deal, or French-polished if constructed of better wood. The top is of ebonite, and should be drilled with clearance holes for the terminals and valve-clip screws, as shown in the drawing. Holes must also be drilled for the filament resistance fittings and for the plug-socket screws. In this instrument the writer has used for the first time a form of filament resistance in which contact is made with the resistance wire by means of a long spiral. This gives a smoother action than the better-known type.

The plug-socket is one sold for fitting to coils, and in order to adapt it to this instrument the curved portion on which the coil rests has to be cut off. Nr. 6 B.A. screws pass through clearance holes in the ebonite, and hold the plug from the back. These also afford the necessary connections with the coil above.

Figures 3 and 4 show the underside of the panel. Three fixed condensers are used, one for the grid (0·0002 mfd.), one across the H.T. battery (0·01 mfd.) and one across the output terminals (0·001 mfd.). The first and third are secured by means of 6 B.A. screws in blind holes tapped into the ebonite (washers gripping the lugs), and the second is held by the locking screws of the two H.T. terminals. The grid leak is of the lead-pencil type on bakelite, of a valve of 1½ megohms. This is also secured by 6 B.A. screws tapped into the ebonite.

In the layout of this instrument care has been taken to keep all the leads as short as possible. An external telephone transformer is used with L.R. telephones.

OPERATION.

The operation of this instrument is rather tricky at first as simultaneous tuning of two condensers is generally required. In his paper* Mr. Phillips gave useful tables of coils for various wavelengths. For short wave work the tuning condenser for the reactance coil should be of not more than 0·0001 mfd. maximum capacity, although larger condensers can be used on long waves.

A good method of beginning work with this set is to take a buzzing wavemeter (the "Townsend" type serves admirably) and hold it near the reactance coil. If the wavemeter is set to, say, 360 metres, the correct reactance coil being in its plug-socket, vary the tuning condenser until maximum strength is obtained in the telephones. The wavemeter, still buzzing, should then be set near the tuner and this adjusted until maximum strength is once more obtained, the reactance tuning condenser being left as previously adjusted. After a little practice with a wavemeter, signals can be tuned in with comparative ease, particularly when notes have been made of the best adjustments.

VALVES.

Good results are obtained with V24 valves in both clips, using 30 volts on the plates. A little better results are found by using a "QX" as the detecting valve. Best of all are two QX valves with 60 volts on the plates.

CONVERSION TO LONG WAVES.

For long wave work the large multilayer coils can be used, but it is far simpler to connect a resistance of about 80,000 ohms across the two condenser terminals in place of the condenser. The amplifier is then of the ordinary resistance-capacity coupled type. Another method is to fit the resistance to a plug, and to substitute it for the coils, the condenser being of course removed.

RESULTS.

On the aerial described in *The Wireless World and Radio Review* for April 1st, page 13 (50 ft. long by 20 ft. high, and using reactance capacity coupling), the Hague Concerts come in on the two valves without difficulty, tuning being sharp and selective. On long waves American stations can frequently be heard.

*Wireless World and Radio Review*, April 8, 1922.

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# Experimental Station Design

(*Continued from page 454, July 8th, 1922.*)

*These articles, which appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## VIII. A SIMPLE VALVE RECEIVING SET.

HAVING completed the construction of the single valve panel described in the previous article under this heading, it now remains to explain the method for connecting up and operating the panel for the reception of signals and in particular the telephony that is transmitted on wavelengths between 300 and 450 metres.

There are many designs for the construction of tuning coils, but in order that the reader may not be delayed further by the necessity for making other instruments, the tuning coils described in an earlier issue* can be made use of. These should be wound exactly as described, two such coils being required, one for connection in the aerial circuit and marked "A" on the panel, and the other which is necessary to produce reaction effects is connected to the terminals "R."

An accumulator is necessary for providing the current for heating the filament of the valve. Most valve filaments need only 4 volts for this purpose, and consequently a 4 volt 20 ampere hour accumulator will suffice. It is inadvisable to select a battery with less capacity than that suggested, as it will need to be in use for several hours at a time. Moreover the ambitious experimenter will not be content with a single valve set for very long, the addition of amplifying valves increasing the current consumption.

The high tension battery may be of any well-known make, and those made up in 15 volt units can be specially recommended. Three 15 volt units providing 45 volts will operate most of the receiving valves at present on the British market. These batteries must be connected in series, that is, the negative, end of the first battery is taken to the negative H.T. terminal of the panel, its positive end being connected to the negative end of a second battery, the positive end of which is taken to the negative end of a third battery, which has its positive end ready for connecting to the H.T. positive terminal of the panel when the remainder of the apparatus has been connected up. It is always advisable when connecting up a valve circuit to leave the joining up of the H.T. terminal until last, for should an error in connection have been made whilst the H.T. battery is connected, it will probably be found to have become completely discharged, even if only left erroneously connected for a brief interval. It is a good plan before finally joining up the positive lead of the H.T. battery to make a test between this lead and the terminal to which it is to be joined, by moistening the fingers and touching them on to the points to be connected. If a slight shock is felt a faulty connection must be looked for. By moistening the fingers and applying them across the main terminals of the H.T. battery a test is afforded as to its condition, as most individuals are susceptible to a slight shock when making contact with a potential as low as 45 volts.

Telephone receivers of high grade manufacture as referred to in a previous article are required, and should have a total resistance of not less than 4,000 ohms. To minimise distortion in the reception of telephony, it is not necessary that they should be of the type having adjustable pole pieces. The reader should acquaint himself with the many types at present on the market before purchasing, in order that he may be satisfied that he has secured receivers of the most reliable make. It is false economy to save a few shillings by purchasing inferior telephone receivers. The use of a telephone transformer is not advocated here. In the course of these articles, the construction of such a piece of apparatus suitable for use with high resistance telephones as mentioned above will be described.

In procuring a valve, one having fairly good rectifying properties should be asked for, and that known as the "R" type is particularly suitable. Other types which give good or perhaps slightly better results are the "R4B," "Q," and "QX," the latter two requiring adapters for fitting to the standard valve holder. All of these valves have a cylindrical plate and spiral grid totally surrounding the filament. There are many small tubular types of valves with four-pin sockets having electrodes arranged in this manner, and these, although admirably suitable for operation in special circuits cannot be recommended for use with this outfit.

For telephony reception a variable condenser is practically indispensable. Although it is intended to describe the construction of one of these instruments subsequently, the reader, unless possessed of a lathe, is advised to buy one. Variable condensers for use in valve circuits should be of the air dielectric type, that is, the space between the

**Wireless World and Radio Review*, p. 327, June 10th, 1922.



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fixed and moving plates should be occupied by no other insulator than air. One of specially large capacity need not be selected. It would be more expensive, and owing to its large dimensions would not be capable of giving fine adjustment. A condenser having a maximum capacity of not more than 0·001 microfarads should be obtained if the chief aim of the reader is the reception of short wave signals, and in any case a cheap low capacity variable condenser is always useful. This instrument will probably have an ebonite knob for revolving the moving plates, and it is advisable not to put it into use without providing an extension arm so that adjustments can be made without bringing the hands near to the plates, which is apt to cause small variations of tuning. A small hole drilled into the side of the knob and tapered by means of the tag of a file can be made to firmly hold the tapering point of a 5 in. piece of ¼ in. ebonite rod.

In connecting up the outfit, the aerial is taken to one terminal of the aerial tuning condenser, the other terminal of which is connected to one end of one of the inductances. This end is also taken to the terminal marked "A1." The other end of this inductance is connected to the terminal marked "A2," and also to the earth wire. In the diagrams of the valve panel, terminals were shown marked "aerial" and "earth." These were provided for subsequent use should the experimenter decide to convert the detector panel into a complete receiving tuner, in which case these terminals would be needed. To obviate the connecting of two wires under each of the terminals "A1" and A2" internal connections may be made across between "A" and A1," and "E" and "A2" (Fig. 1, page 455). The inductance will then remain connected on the "A1" and "A2" terminals, whilst the lead from the variable condenser will pass to terminal "A" and the earth wire will be connected to terminal "E." A similar inductance has its ends connected to the terminals marked "R1" and "R2." The H.T. and L.T. batteries, the telephones, and the insertion of the valve complete the connecting up of the set.

The method of operation is first to adjust the brightness of the filament to nearly maximum. There is little danger of burning the filament out when working from an accumulator of only four volts. The aerial tuning condenser is set to a mid-position adjustment and the aerial and reaction coils are placed almost completely over one another. If a shrill whistling noise is heard the top coil should be slowly pushed away from the other with a small piece of ebonite until the noise just ceases. If no whistling is heard a click should be obtainable in the telephones as the two coils are moved apart. If this is not obtained, one of the coils should be turned over and the test repeated. The turning of the aerial tuning condenser should now bring in signals. The overlap of the coils should be kept at a minimum during reception, and they should only be sufficiently close to bring in the signal. Too much overlap will reduce the signal strength, but, moreover, and this is very important, excessive overlap will give rise to the production of oscillating current in the aerial circuit of sufficient intensity to cause interference with other receiving stations which may be near by.

It is probable that the experimenter will receive, first of all, ship and coast stations on wavelengths of about 600 metres and in searching for telephony the aerial tuning condenser must be turned to a smaller value than is required to bring in 600 metre transmissions which can be recognised by their buzzing note. These stations use transmitters of the spark, or damped wave type, which can be identified by the fact that no variation is obtained in the pitch of the note as the tuning is altered. Telephony reception, particularly from amateur stations, is usually attended by a shrill note which fluctuates with movements of the aerial tuning condenser, and it is frequently very difficult to tune in speech transmitted on low power, away from noise of this kind, generally referred to as the "carrier wave." With moderately high power transmission, however, there is no difficulty in tuning into the telephony by critically adjusting the variable condenser by means of its extension handle. A refinement that facilitates critical adjustment is the connection of a small value (0·0005 microfarads )variable condenser across the reaction coil.

F. H. H.

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## Sir Oliver Lodge's Address to the Wireless Society of London

The following is the text of a letter received from Sir Oliver Lodge, F.R.S., regarding his address to the Wireless Society of London, published in our issue of July 1st. Sir Oliver Lodge suggests that the letter should be published as a means of drawing attention to one or two corrections to be made to the report of his address.

*10th July*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I regret that I had not time to correct and amplify the report of my lecture to the Wireless Society, published in your July issue. But the report is very well done, and someone has kindly corrected it for me. There remain only a few errata, of which I need only mention the following:—

Middle of first column, p. 409:—"The ether being the light" should be "the ether being treated as an elastic solid."

In the first equation on p. 409, p should be $2\pi$.

The first paragraph on p. 412 should be in quotation marks, because it was the footnote with which I concluded my Paper on Electric Waves in the *Phil. Mag.* for August, 1888; the preceding paragraph being also a virtual, though rough, quotation from the conclusion of that same Paper.

Near end of second column on p. 415, 1889 should be 1899.

Yours faithfully,

(Signed) OLIVER LODGE.



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# Some Effects of Capacity on Mutual Induction

*The following is a reply to the discussion on the paper read by Mr. J. H. Reeves on the above subject.*

**Mr. J. H. Reeves** (*in reply communicated*).

Prof. G. W. O. Howe has brought to my notice a paper by himself written in 1912 (*Electrician*, Vol. 68, p. 1,017) in which he showed that the effect of electrostatic coupling helps or opposes that of electromagnetic according to the direction of winding of the respective coils. Mr. Coursey gives a qualitative explanation of the same phenomenon. Interesting though this is, I do not see how to use it for improving the design of reception coils unless numerical values can be calculated for coils of stated dimensions, and he gives no hint how these calculations can be made as regards the co-efficient of electrostatic coupling. Mr. Carpenter gives precise direction as to where to seek for the necessary expressions, but Washington, U.S.A., is rather far for the amateur. I will try to get a copy but wish it could be bought in this country.

I draw so much distinction between the two types of electrostatic coupling because I found in practice there is a great difference in action as regards passing through jamming signals, and I will state in greater detail the experiments which made me abandon the variable condenser coupling. I used my No. 40 coils very loosely coupled, fully one foot apart, so that the coupling should be almost entirely static. I arranged the variable condenser and the static coupler circuits so that each could be coupled up instantaneously through one of two plugs. Using the latter coupling first I tuned into 400 metres by a buzzer wavemetre and then, bringing in the other, I adjusted the condenser till the strength of the signals was as nearly as I could judge the same. Hence I concluded I had reached Mr. Coursey's criterion of equally effective capacity couplings. With the circuits left in this adjustment I listened in for the **FL** 9.30 G.M.T. time signals. These were easily readable on the condenser coupling, quite inaudiable on the static coupler connection. I changed over to single circuit working. **FL** continued to come through with some variation in strength. I turned back to coupled circuit working (a single switch makes these changes) and disconnected the earth connection of the A.T.I. **FL** came through the secondary with appreciable, but small, alteration of strength, but was again inaudible on the static couplers.

My theory is that when the **FL** wave effect reaches the junction of the end of the A.T.I. and the lead to the secondary *via* the coupling variable condenser it has two paths in parallel direct to earth, and the oscillations forced on either of these is independent of that on the other, or nearly so, while in the case of the static couplers the **FL** wave effect sets up forced oscillations in the A.T.I., altered possibly, but very slightly, by back action, from the encircling strip. The forced oscillations, greatly diminished in strength, are passed on to the second strip, and by it, with still further diminution, are passed on to the secondary. This may also explain my observations on atmospherics. I was unable to listen in for some days preceding the reading of the paper as I was in bed by medical orders. The fact that atmospherics were exceptionally bad during those days makes me regret still more my enforced abstinence from wireless work. I hope, however, to be able one day to take my set of No. 40's over to Mr. Blake on a really bad day and we will have a comparison between these and the Reinartz set he so interestingly described.

In reply to Mr. Blake's enquiry as regards signal strength I will include an allusion to Mr. Child's suggestion that I use extra high amplification. The 55D was designed more for simplified working over a large range than for high efficiency on any one; further, its minimum range is 1,500 metres and most of my later work has been done on 600 and 400, with only four V.24's instead of the full number of six. Hence the H.F. amplification is certainly not extra high, and indeed on a friend's circuit with one H.F., tuned transformer coupled, I have heard better than with my four. As regards long distance 600 metres work, the best I have got, with No. 26 coils, magnetic coupling only has been Alexandria, **SUH**. With the same amplification, using my No. 40's feet apart and relying on the static coupling only, Mr. Murchie and I have read a ship answering Ajaccio, **FUI**. Hence as regards reception, provided reaction just short of oscillation is used, there would seem to be little difference. There has been marked difference as regards elimination of jamming by the alternative methods of (*a*) very loose magnetic coupling; (*b*) balancing magnetic against electrostatic, whether by means of the inherent self-capacity of No. 26 coils, wound with the turns touching, or by the No. 40 coils using static couplers. I refer Mr. Blake to my early remarks *re* eliminating **GFA** from Croydon and Mr. Child's telephony. I am not expert enough to be able to recognise with certainty the harmonics of **GBL**. There is a frequent harmonic in the neighbourhood of 600 metres. With the No. 40's this is reduced to a restricted band on either side of which ships come through on their natural note.

From Mr. Child's remarks about the way my coils and apparatus generally are well spaced, it would seem that my reception unit is of unwieldy dimensions, so I have had the curiosity to make a few measurements. The base is a cupboard, floor area 23 ins. by 18 ins; in this are the batteries and spares. On the top back of this is a series of panels 18½ ins. by 11 ins. mounted vertically over one another. This leaves a shelf 23 ins. by 7 ins. on which can rest any set of coils with which I am experimenting. The base area of my No. 40 set is 17 ins. by 4 ins., and the 17 ins. could be made 14 ins. by altering the reaction adjustment. Surely these dimensions are smaller as regards "room-occupying" space than those of many of which photographs have appeared in *The Wireless World*. I would willingly double all if by so doing I could get nearer to perfection in the elimination of jamming and distortion.

The close agreement of the estimates of Mr. Phillips and Mr. Child as to capacity values is interesting. I can only regard as a lucky chance the fact that the first pair of laminated couplers came so closely to about the right order of things. I have not yet had time to try the effect of making them smaller or larger, but as soon as I get H.F. amplification more suitable for 400 metres and under I will try varying their magnitude.

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# The Elementary Theory of the Thermionic Valve*

By GORDON FRYER, L.D.S., R.C.S.Eng.

*Vice-Chairman of the Hounslow and District Wireless Society.*

THE subject of my paper is the elementary theory of the thermionic tube or valve as we are in the habit of calling it, and after the interesting lectures and demonstrations that we have had in the recent past, I fear the subject may appear somewhat tedious.

I do not claim anything original in what I may say, but I am only trying to explain in a simple manner the present accepted theory which you may read much more fully in any text-book dealing with the subject.

From this you may gather that I am addressing primarily those among you who have but recently entered upon this fascinating branch of science.

Roughly, we may divide those interested in wireless into three classes.

There are first, those whose chief interest is in making wireless sets and tuners and in turning out beautifully polished panels and cabinets; in other words, their bent is to be wireless instrument makers. Secondly, we have the men who, having obtained or made a set of some kind or other, devote their time to reading the Morse messages, their ambition being to become more or less efficient operators. And, thirdly, we have the class to which we amateurs chiefly belong, who, without neglecting the constructional and operating side, are far more interested in experimental work, in trying new circuits and instruments, always with the idea and hope of bettering our present one and with ever the possibility of discovering something new that may advance the science.

But before we can reach this stage of amateur research work, we must obviously know exactly what our instruments are doing, how they do it, and why.

There must be no gadget on our bench whose use we do not know, and we must be able to picture in our minds what is actually taking place at any point of our circuit. And if this evening I am able to assist any of you over the first fence of the difficult course of wireless theory, my object will have been accomplished.

If I crush a piece of chalk into a very fine powder and take the smallest particle of it which is hardly visible to the eye, it would still appear quite large under a microscope. If this were further divided into innumerable smaller particles, we should at length reach a stage where it could no longer be divided without destroying its character as chalk.

This smallest particle of any element or compound that can exist of itself is called a molecule.

Each molecule consists of one or more atoms, which may be defined as the smallest part of an element which can enter into combination with another atom. (See Fig. 1.)

Now, let us consider the structure of one of these atoms.

According to what is now known as the electron theory, an atom consists essentially of a central nucleus or core around which revolves at varying distances one or more corpuscles which are called electrons.

Of the central nucleus we know very little, except that its mass is very much greater than the electrons that revolve around it, and that it is supposed to consist essentially of positive electricity.

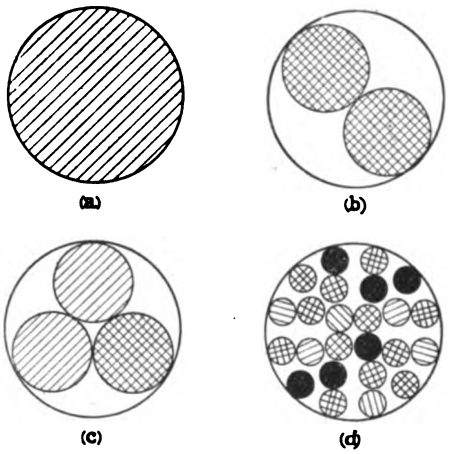


*Fig.* 1. *Diagrammatical representation of* (a) *A molecule of Hydrogen consisting of one atom.* (b) *A molecule of Oxygen consisting of two atoms.* (c) *A molecule of Water consisting of two atoms of Hydrogen and one of Oxygen.* (d) *A molecule of Sugar consisting of six atoms of Carbon, twelve atoms of Hydrogen and six atoms of Oxygen.*

However, it is not so much the central core in which we are interested this evening as in the revolving electrons.

Each electron is of infinitely small size, and is supposed to consist of negative electricity.

The number of these electrons, their distance from the centre and their relative positions, are different in every element, and it is these electrons which are supposed to give to an element its chemical properties. Thus, the difference between lead and gold may be that the atoms of the one possess a greater number of electrons than the other (Fig. 2), and so if we were able to vary the number of electrons in an atom we should be able to change lead into gold, which would be most unfortunate. However, no physical forces at our disposal have so far been able to alter in the slightest degree the structure of the atom, although we have in what are known as radio-active substances, *e.g.*, radium and uranium, examples of atoms emitting some of their electrons. This process, however, takes place very

* A paper read before the Hounslow and District Wireless Society on May 18th, 1922.

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slowly, in fact it would take 50,000 years for a piece of radium to change into an element of slightly different characteristics.

The size of the atom may be likened to the dome of St. Paul's Cathedral; an orange suspended by a thread would represent the central nucleus and several flies circling round relatively show the size of the electrons.

The atom with its nucleus and revolving electrons may be likened to our solar system; the size of the atom to the Solar system is as $1 : 10^{22}$. Now, although you can see at a glance what a tremendous size this figure is, you will gain a better idea of its

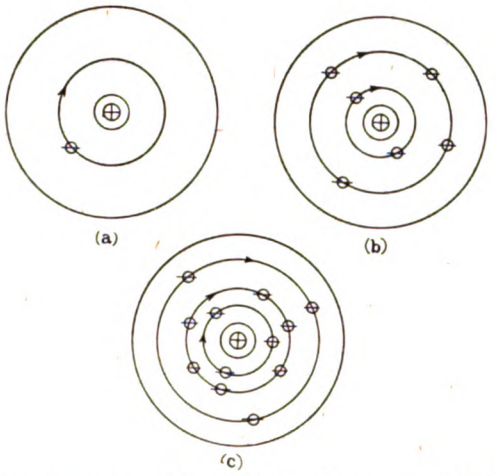


*Fig. 2. Atoms of three different elements.* (a) *With one electron revolving round the positive core.* (b) *With six electrons in two orbits.* (c) *With twelve electrons in three orbits.*

size if you will try and imagine that an atom with its electrons and nucleus is actually a sun with its revolving planets, and let us imagine that one of these electronic planets be peopled as the earth is. Now, even as their size is $10^{22}$ times smaller than ours, so is their time. In other words, one of our seconds is equal to $10^{22}$ of their seconds.

This time is so short that hundreds of thousands of years of their time pass during a second of ours. It is thus quite impossible for us to destroy one of the worlds.

A book written by Prof. Fournier d'Albe, called "The Infra and Supra Worlds," deals with this fascinating theory, and I should recommend any of you sufficiently interested to read it.

Now besides these fixed numbers of revolving electrons in an atom, there are other electrons which are called free electrons because they are able to move freely between atom and atom, and under suitable conditions are able to leave the atom altogether. They, also, consist of negative electricity and their number varies in every element, and they are supposed to give to an element its physical properties. It is these free electrons which take part in electrical phenomena. A substance that contains many of these free electrons, which are easily movable from atom to atom, is a good conductor of electricity such as the metals, as a current of electricity, as we shall see later, is simply a flow of these free electrons from molecule to molecule.

Now, under normal conditions, all the electrons which, as I have said, consist of negative electricity, neutralise the positive core in an atom, which thus possesses no electrical charge. If, however, we take a number of these free electrons away from the atom, the positive charge in the case will preponderate, and the atom will possess a positive charge, and the more electrons we take away the more positive it becomes; thus, by withdrawing electrons from an uncharged or neutral piece of matter we may be said to give it a positive charge.

Similarly, if we add electrons to an atom it will become negatively charged. A positively charged atom is called a positive ion, and a negatively charged atom is called a negative ion.

According to the well-known law, like repels like and attracts unlike. Thus two bodies negatively charged will repel one another, but would attract an uncharged or positively charged body, and if we have two bodies, one of which possesses a greater number of free electrons than the other, it is said to be at a higher negative potential than the other, and if these two bodies be brought together until they touch, the electrons will flow from the one with the higher negative charge to the other until they are both of the same potential.

If, however, the difference in potential between the two bodies is very great and they are brought towards each other without touching, the electrons will fly across from the one to the other, producing in their passage through the air an electric spark (Fig. 3), which is simply the heated molecules of air caused by the friction of the electrons as they pass through it at terrific speed.

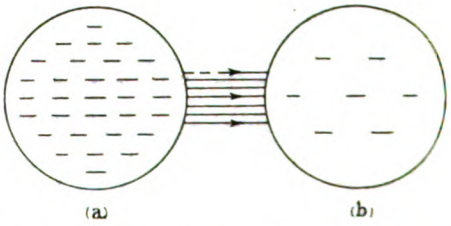


*Fig. 3. Represents two atoms* (a) *possessing a negative charge or surplus of electrons.* (b) *possessing a positive charge or deficiency of electrons; if brought near together, electrons fly across to the atom with the positive charge.*

The free electrons are in continual motion in the atom, and their speed increases with the temperature.

If we heat some water in a kettle the molecules of the water increase their speed until at last they are able to overcome the pressure of the atmosphere and leave the water issuing from it as steam. Now exactly the same thing occurs with electrons.

If we heat a piece of wire, say, by means of an electric current flowing through it, the movements of the electrons will increase in speed as the temperature is raised, and if we take away the pressure of the atmosphere their speed will increase much more rapidly.

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I have gradually, step by step, been leading up to the point where we are in a position to understand what takes place in a wireless valve.

*Fig.* 4.

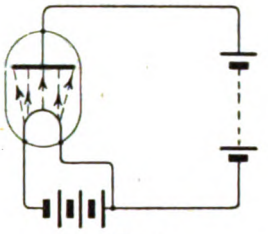

*Fig.* 5.

*Fig.* 4. *Showing electrons leaving and returning to heated filament.*

*Fig.* 5. *A plate with a positive charge inserted, showing a regular flow of electrons from the heated filament to the plate.*

In an assembly such as the present, there is no need for me to describe the valve in great detail, but essentially it consists of a glass bulb, highly exhausted of air in which is first a filament of tungsten, of which we can raise the temperature by means of a 4 to 6 volt accumulator. Secondly, there is sheet of nickel, which is generally of cylindrical form, and surrounds the filament, it is called the plate; and, thirdly, we have between these two and somewhat nearer the filament what is known as the grid. This takes various forms according to the make of valve, but usually it consists of a spiral of fine molybdenum wire. Two of the legs of the valve belong to the filament, one goes to the plate and the other to the grid.

Let us see what takes place when we heat the filament, ignoring for the present the plate and grid.

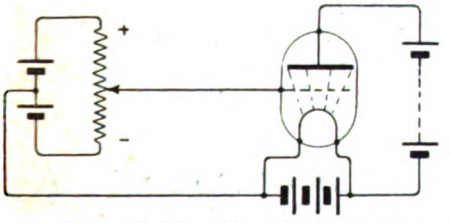


*Fig.* 6. *Valve circuit with grid connected to the centre of the potentiometer and so having no charge on it. The grid here does not interfere with the normal flow of electrons.*

As the temperature of the filament is raised, the free electrons vibrate at a rapidly increasing rate. At length their speed is so great that they are able to leave the filament altogether (Fig. 4.) Here they meet the resistance caused by the molecules of gas still left in the bulb. Their energy is rapidly exhausted and they return to the filament in exactly the same way that a stone thrown in the air returns to the ground.

We thus have a cloud of electrons surrounding the filament, and this is called the space charge as it really constitutes a negative charge in space.

Now any electrons leaving the filament have to overcome three things:—

First the attractions of the positive core.

Second, the resistance caused by friction between the molecules of gas in the bulb.

Third, the repulsion caused by cloud of electrons.

But as the electron travels further from the filament the number of electrons of the space charge in front decrease and those behind increase until at last the space charge would be helping the electron on its way from the filament.

Now let us introduce a thin unconnected metallic plate some distance from the filament. This plate has no charge and is therefore at a higher positive potential than the rest of the bulb. Electrons which always tend to flow from a point of low positive potential to one of high potential will therefore accumulate on the plate and charge it negatively. This will continue until the plate is so negative that it begins to repel electrons which were going to it.

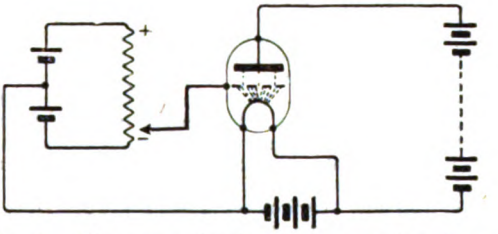


*Fig.* 7. *The same circuit with a negative charge upon the grid, which lessens the flow of electrons to the plate.*

Now having considered an isolated plate, let us suppose we give the plate an electrostatic positive charge. Since the plate is positive it has had electrons taken away from it, and it makes good the deficiency by attracting to itself the electrons which are being emitted by the filament. I may mention here that the attraction of the plate causes a strain on the filament itself, so that sometimes it may even break the filament. This is the reason that the plate is usually in the form of a cylinder around the filament.

Now by connecting the positive of the battery to the plate, and the negative to the filament, as in Fig. 5, we shall maintain a constant positive potential on the plate and maintain a constant flow of electrons from filament to plate. This is called the plate or anode current.

This constitutes the two-electrode valve or Fleming valve.

The essential feature of the three-electrode valve is the grid.

The function of the grid is to control the flow of electrons that we have just been considering, and it is sometimes called the "control electrode."

Now let us connect up a circuit as in Fig. 6, by which means we are able to place a varying potential upon the grid.

Starting with no charge upon the grid, the flow of electrons to the plate circuit is normal (Fig. 6), but if we put a negative charge upon the grid, it will now repel many of the electrons that would have

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gone to the plate. This means less plate current, and as we increase the negative potential upon the grid, we shall at length reach a point where the charge upon the grid is so great that it will turn

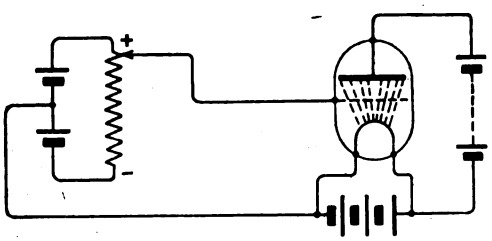

*Fig. 8. The same circuit as in 6, but with a strong positive charge on the grid, causing a greatly increased flow of electrons to the plate.*

back all the electrons that would have gone to the plate. The plate current would now be zero. (Fig. 7.)

Conversely, if we put a positive potential on the grid the plate current is increased, and if we keep increasing the positive potential on the grid a point will at length be reached when all the available electrons are going to the plate, after which any further increase of positive potential would have no further effect. This is called saturation point, and is illustrated in Fig. 8.

So you may see that by altering the potential of the grid we can vary the plate current from zero to saturation value

I have given in Fig. 9 a curve to show the value of plate current for different values of grid potential.

You will see there are two bends to the curve. The one A is due to the space charge which decreases as the potential of the grid rises and the one at B is due to the effect of saturation.

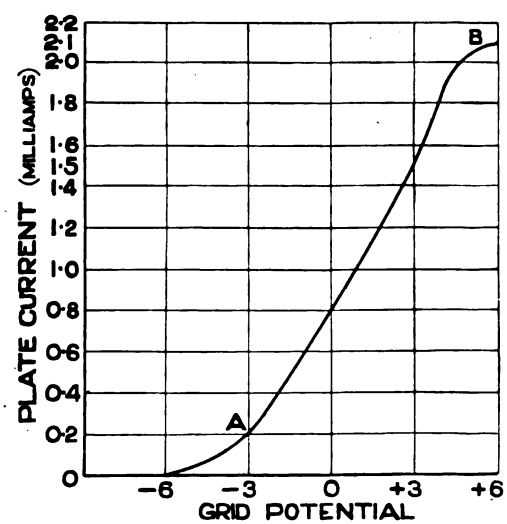


*Fig. 9. Curve showing effect of varying the grid voltage upon the plate current.*

The portion between A and B is fairly steep; this means that small variations of grid potential will cause large variations of plate current.

Now without going into any further details I conclude with a diagram (Fig. 10) which shows how we use the valve in a simple wireless circuit.

Electrons are emitted from the heated filament; these are attracted to the plate, which is kept at

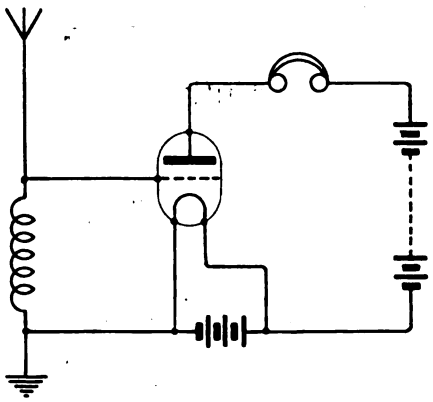

*Fig. 10. Simple valve circuit to show how a varying potential is put upon the grid by the incoming oscillations in the aerial circuit.*

a positive potential by the H.T. battery, so that we have a continuous regular plate current. The telephone is inserted in the plate circuit, but, of course, while the current in the plate circuit is steady it has no effect upon the telephones. The grid is connected to the aerial, and the oscillations sent out by the transmitting station cause a varying potential of the grid, which in its turn varies the plate current. These variations affect the telephones and we get signals.

# The Wireless Society of London.

**The new session of the above Society will commence in September next. Application for membership or for affiliation of Provincial Wireless Societies should be made to:**

**The Hon. Secretary,**
**(Mr. L. H. McMichael)**
**32, Quex Road,**
**London, N.W.6.**

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# Amplitude of Electrical Oscillations Generated by Electron Tubes.*

By G. BREIT.

THE calculation of the amplitude of electrical oscillations generated by electron tubes has been treated by Van der Pol and by Moeller by different methods.† In this paper a still different method of discussing the question is indicated.

This method is based on the geometrical fact that a curve may be approximated by a polygon (inscribed or circumscribed). It thus substitutes a polygon for the characteristic curve of the tube. It is clear that the general method may be also used in other problems in which the connection between two of the variable quantities is not linear provided the problem can be solved for the case in which this connection is linear.

The fact that the polygon is never an exact substitute for the curve offers no difficulty because the graphical solution of the transcendental equations involved can be carried out with practically as much ease for a polygon with many sides as for a polygon with few sides. Thus, the approximation can be always made as close as is desired.

## Notation and Assumptions.

The symbols and quantities used are illustrated in Fig. 1.

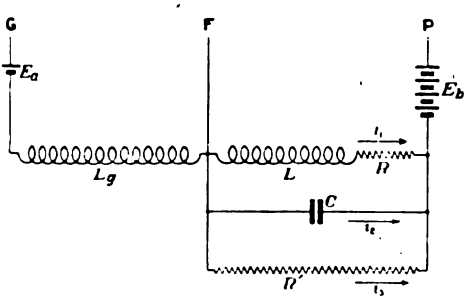


*Fig* 1.

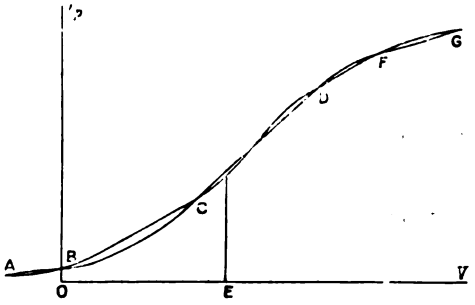


*Fig.* 2.

G denotes grid terminal of valve.
F denotes filament terminal of valve.
P denotes plate terminal of valve.
$E_a$ = Voltage of grid battery reckoned positive when + terminal faces grid.
$E_b$ = Voltage of plate battery reckoned positive when + terminal faces plate.
$L$ = Inductance of plate coil.
$R$ = Resistance of plate coil.
$C$ = Capacity of plate circuit condenser.
$R'$ = Leakage resistance of plate circuit condenser.
$M'$ = Mutual inductance between plate and grid coil, reckoned positive when the mutually induced e.m.f. is of same sign on G and P with reference to F.
$V_p$ = Excess of potential of P over that of F.
$V_g$ = Excess of potential of G over that of F.
$i_p$ = Plate current reckoned positive when flowing from plate to filament inside tube.
$i_1$ = Current through plate circuit inductance from F to P.
$i_2$ = Current through plate circuit capacity from F to P.
$i_3$ = Current through leakage resistance of plate circuit capacity from F to P.

The current $i_p$ is composed of the three currents $i_1$, $i_2$, $i_3$, shown on the figure, *i.e.*,

$$i_p = i_1 + i_2 + i_3 \quad \ldots \quad (1)$$

It will be assumed that $i_p$ is a function only of $V_G$, $V_P$ and that this function is of the form

$$i_p = f(V_P + \mu V_g) \quad \ldots \quad (1')$$

where $\mu$ is a constant called the amplification constant of the tube. The grid current will be neglected throughout.

---

* Received December 22nd, 1921.

† BALTH. VAN DER POL, Jun. *Radio Review*, 1, pp. 701-710, November; and pp. 754-762 December, 1920. HANS GEORG MOELLER. "Die Elektronenröhren." (Published by Vieweg & Sohn.) P. 79.

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**Derivation of the Fundamental Equation.**

Since the potential differences across the coil ($R$, $L$), across the capacity $C$, and across the leakage resistance $R'$ are equal we have

$$\left(L\frac{d}{dt} + R\right) i_1 = \int_0^t \frac{i_2}{C}\,dt = R' i_3$$

or

$$i_2 = \left(LC\frac{d^2}{dt^2} + RC\frac{d}{dt}\right) i_1$$

$$i_3 = \left(\frac{L}{R'}\frac{d}{dt} + \frac{R}{R'}\right) i_1$$

Hence by (1)

$$i_P = \left[LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}\right] i_1 \quad \ldots\ldots\ldots \quad (2)$$

Further

$$\left.\begin{aligned} V_P &= E_b - \left(L\frac{d}{dt} + R\right) i_1 \\ V_g &= E_a - M\frac{di_1}{dt} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots \quad (2')$$

so that

$$V_P + \mu V_g = E_b + \mu E_a - \left[(L + \mu M)\frac{d}{dt} + R\right] i_1$$

or letting

$$\left.\begin{aligned} V_P + \mu V_g &= V \\ E_b + \mu E_a &= E \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2'')$$

We have

$$V - E + \left[(L + \mu M)\frac{d}{dt} + R\right] i_1 = 0 \quad \ldots\ldots\ldots \quad (2''')$$

Operating on this with $LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}$ and using (2) we obtain

$$\left[LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}\right] V + \left[(L + \mu M)\frac{d}{dt} + R\right] i_P = \left(1 + \frac{R}{R'}\right) E \quad \ldots \quad (3)$$

This is the fundamental equation of the problem.

**Method of Solution.**

It was assumed that

$$i_P = f(V) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Thus it is required to find a solution of (3) for which (4) is satisfied. The relation (4) may be represented graphically as in Fig. 2.

The method of approximation consists in inscribing polygons in the curve representing the relation (4) as *e.g.*, the polygon A B C D F G. For any side of the polygon we have

$$f(V) = a + bV$$

Thus substituting into (3) a new variable $v$ defined by

$$v = V - \frac{E - \dfrac{aR}{1 + R/R'}}{1 + \dfrac{bR}{1 + R/R'}} \quad \ldots\ldots\ldots\ldots\ldots \quad (4')$$

and replacing the differential operator $\frac{d}{dt}$ by a variable $\xi$ in the usual way we obtain the quadratic

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equation

$$LC\xi^2 + \left(RC + \frac{L}{R'} + b\,(L+\mu M)\right)\xi + 1 + \frac{R}{R'} + bR = 0$$

The two roots of the equation we denote by $a$ and $\bar{a}$.

In terms of these

$$v = A\,\epsilon^{at} + \bar{A}\,\epsilon^{\bar{a}t} \quad \ldots\ldots\ldots\ldots\ldots \text{(I)}$$

where $A$, $\bar{A}$ are arbitrary constants. Differentiating (I) we have

$$\dot{v} = Aa\,\epsilon^{at} + \bar{A}\bar{a}\,\epsilon^{\bar{a}t} \quad \ldots\ldots\ldots\ldots\ldots \text{(II)}$$

Multiplying (I) by $a$ and subtracting * from (II).

$$\dot{v} - av = \bar{A}\left(\bar{a} - a\right)\epsilon^{\bar{a}t}$$

Writing the above equation for $t = t_1$ and for $t = t_0$ and taking the ratio of the two we get

$$\frac{\dot{v}_1 - av_1}{\dot{v}_0 - av_0} = \epsilon^{\bar{a}(t_1 - t_0)} \quad \ldots\ldots\ldots\ldots\ldots \text{(III)}$$

Similarly, on multiplying (I) by $\bar{a}$, subtracting from (II) and taking the ratio of the results for $t = t_1$ and $t = t_0$ we get

$$\frac{\dot{v}_1 - \bar{a}v_1}{\dot{v}_0 - \bar{a}v_0} = \epsilon^{a(t_1 - t_0)} \quad \ldots\ldots\ldots\ldots\ldots \text{(IV)}$$

and eliminating $t_1 - t_0$ between (III) and (IV).

$$\frac{(\dot{v}_1 - av_1)^{\bar{a}}}{(\dot{v}_1 - \bar{a}v_1)^{a}} = \frac{(\dot{v}_0 - av_0)^{\bar{a}}}{(\dot{v}_0 - \bar{a}v_0)^{a}} \quad \ldots\ldots\ldots\ldots\ldots \text{(V)}$$

THIS MEANS THAT $\dfrac{(\dot{v} - av)^{\bar{a}}}{(\dot{v} - \bar{a}v)^{a}}$ REMAINS CONSTANT WHILE ONE OF THE SIDES OF THE POLYGON IS FOLLOWED.

This fact will enable us later to follow the changes in the system while it remains on one side of the polygon.

Further, if the system passes from one side of the polygon to the next $V$ *changes continuously*. This, as we shall show presently, implies also that $\dot{V}$ changes continuously.

In fact, since $V$ is continuous $i_1$ is also continuous because $L$ is an inductance. Consequently, by (2''') $\dfrac{di_1}{dt}$ is continuous and by (4) the same is true for $i_P$. Hence, from (2) we infer the continuity of $\dfrac{d^2i_1}{dt^2}$ and differentiating (2'') we find that $\dot{V}$ is continuous.

In most practical cases $a$ and $\bar{a}$ are conjugate complex numbers. Only these cases will be considered at present.

Since $v$, $\dot{v}$ are real

$$\frac{(\dot{v} - av)^{\bar{a}}}{(\dot{v} - \bar{a}v)^{a}} = \epsilon^{2j\theta}$$

where $\theta$ is real.

Writing $a = \alpha + j\beta$ we have for positive $v$

$$\epsilon^{2j\theta} = v^{2j\beta}\,\frac{(\rho\,\epsilon^{-j\phi})^{\alpha + j\beta}}{(\rho\,\epsilon^{j\phi})^{\alpha - j\beta}}$$

where $\rho = \sqrt{\left(\dfrac{\dot{v}}{v} - \alpha\right)^2 + \beta^2}$, $\tan\phi = \dfrac{\beta}{\dfrac{\dot{v}}{v} - \alpha}$

*The procedure here employed is shorter than that originally used and has been suggested by Prof. H. A. Lorentz.

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Hence, for positive $v$ the quantity

$$\theta = \beta \log v - \alpha \phi + \beta \log \rho$$

$$= \beta \log v - \alpha \tan^{-1} \frac{\beta}{\frac{\dot{v}}{v} - \alpha} + \beta \log \sqrt{\left(\frac{\dot{v}}{v} - \alpha\right)^2 + \beta^2} \quad \ldots\ldots\ldots (5)$$

remains constant during the motion.

Similarly, for negative $v$ the quantity

$$\theta' = \beta \log (-v) - \alpha \tan^{-1} \frac{\beta}{\frac{\dot{v}}{v} - \alpha} + \beta \log \sqrt{\left(\frac{\dot{v}}{v} - \alpha\right)^2 + \beta^2} \quad \ldots\ldots\ldots (6)$$

remains constant.

Theoretically the problem is thus solved because on any side of the polygon either (5) or (6) establishes a connection between $v$ and $\dot{v}$. It is most convenient to express this connection graphically.

## Graphical Methods.

The motion of the system can be studied by means of the curves

$$y = Y(x) = -\alpha \tan^{-1} \frac{\beta}{x - \alpha} + \beta \log \sqrt{(x - \alpha)^2 + \beta^2}$$

drawn for each of the sides of the polygon. The curve will be always supposed to be plotted for positive $\beta$ and has the general shape shown in Fig. 3.

*Case of* $v > 0$.

Let us consider the case of $v > 0$ in more detail. Let us denote $\frac{\dot{v}}{v}$ by $x$. Then in virtue of (5), changes in $y$ are equal and opposite to changes in $\beta \log v$. If now $\dot{v}$ is also positive then $\frac{\dot{v}}{v}$ is positive and corresponds therefore to a point $\overline{A}$ (see Fig. 3) on the right branch of the curve. Since $\dot{v} > 0$, $v$ is increasing, and, hence, by (5) $y$ is decreasing so that the point corresponding to $\frac{\dot{v}}{v}$ slides down the curve. If its

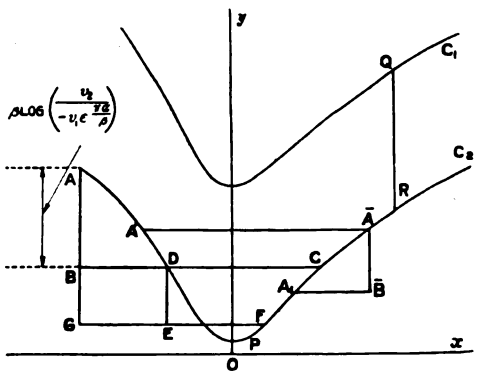


*Fig.* 3.

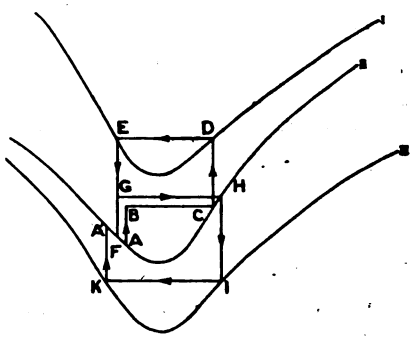


*Fig.* 4.

new position is $A_1$ and if $v_{A_1}$ is the value of $v$ in that position, then by (5)

$$y_A - y_{A_1} = \beta \log \frac{v_{A_1}}{v_{\overline{A}}} \quad \ldots\ldots\ldots (7)$$

In particular if P is the lowest point of the curve

$$y_{\overline{A}} - y_P = \beta \log \frac{v_P}{v_{\overline{A}}}$$

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But at P $\dot{v} = 0$, because $v \neq \infty$ at P.

THEREFORE, IF $v_P = v_{\bar{A}} \epsilon^{(y_{\bar{A}} - y_P)/\beta}$ IS ON THE SIDE OF THE POLYGON THE SYSTEM TURNS BACK AT P AND DOES NOT REACH THE NEXT SIDE.

On the contrary if $v_P = v_{\bar{A}} \epsilon^{(y_{\bar{A}} - y_P)/\beta}$ IS NOT ON THE SIDE OF THE POLYGON THEN THE SYSTEM PASSES ON THE NEXT SIDE.

If the system reaches P and turns back $\dot{v}$ and $\frac{\dot{v}}{v}$ become negative. The value of $\frac{\dot{v}}{v}$ corresponds then to a point on the left branch of the curve; $\dot{v}$ being negative $v$ decreases and hence by (5) $y$ increases. Thus the point moves up the curve. When it reaches a point A′ for which $y$ has the same value as $\bar{A}$ it has by (5) the same value of $v$ as at $\bar{A}$. If this value is one common to two adjacent sides the system passes to the next side at A′.

Thus we found that IF THE SYSTEM TURNS BACK ON THE SIDE OF THE POLYGON AND IF THE VALUE OF $\frac{\dot{v}}{v}$ WHEN IT ENTERS THE SIDE IS THE VALUE OF $x$ AT $\bar{A}$, THEN THE VALUE OF $\frac{\dot{v}}{v}$ WHEN IT LEAVES THE SIDE IS THE VALUE OF $x$ AT A′ WHERE THE LINE $\bar{A}$A′ IS PARALLEL TO OX. (See Fig. 3.)

This presupposes that $v$ does not change sign on the side considered.

If the system passes on the next side and if $v = 0$ is not on the side considered formula (7) suggests a construction for $\frac{\dot{v}}{v}$ at the end of the side opposite to A. If $v_{A_1}$ be the value of $v$ at that opposite end and if $v_{\bar{A}}$ the value of $v$ at $\bar{A}$ then THE STEP $\bar{A}$ B $A_1$ IN WHICH A B $= \log \frac{v_{A_1}}{v_{\bar{A}}}$ GIVES THE POINT $A_1$ AT WHICH $x$ IS THE VALUE OF $\frac{\dot{v}}{v}$ AT THE END OF THE SIDE OPPOSITE TO $\bar{A}$.

*Case of $v = 0$ on the side considered.*

Let us refer to one end of the side by the suffix 1 and to the other by the suffix 2. Let $v_1$ be negative and let $v_2$ be positive and suppose that the system enters the side at 1 with $\dot{v}_1$ positive. Then in the vicinity of 1, $\log(-v)$ is decreasing and therefore by (6) $y$ is increasing. Thus the representative point moves up the left branch of the curve. It moves off to infinity when $v = 0$. When $v$ changes sign $\frac{\dot{v}}{v}$ changes sign and the point reappears on the right branch. Here $\log v$ increases and hence in virtue of (5) $y$ decreases so that the point moves down the right branch of the curve. For some proper value of $y$ on this branch the value $v = v_2$ is obtained. In order to ascertain this value of $y$ it is necessary to ascertain the relation between $\theta$ and $\theta'$.

This may be obtained from the fact that $\dot{v}$ is continuous at $v = 0$. Now clearly for an infinitive $\frac{\dot{v}}{v}$ and for a finite positive $\dot{v} = \dot{v}_0$ at $v = 0$

$$\theta = \beta \log \dot{v}_0 \quad , \quad \theta' = \beta \log \dot{v}_0 - \pi\alpha$$

because $\tan^{-1}(-0)$ in this case is $\pi$ since $\tan^{-1}$ passed through $\frac{\pi}{2}$ for $x = \alpha$ and after that went into the second quadrant.

Thus

$$\theta = \theta' + \pi\alpha$$

Hence, since

$$\theta' = \beta \log(-v_1) + y_1, \quad \text{and} \quad \theta = \beta \log v_2 + y_2$$

we have

$$y_1 - y_2 = -\pi\alpha + \beta \log\left(\frac{v_2}{-v_1}\right) = \beta \log\left(\frac{v_2}{-v_1 \epsilon^{\pi\alpha/\beta}}\right)$$

Thus if $v_1 < 0$ and $v_2$, $\dot{v}_1$ are $> 0$ WE STEP DOWN BY THE AMOUNT $\beta \log \frac{v_2}{-v_1 \epsilon^{\pi\alpha/\beta}}$ AND PASS TO THE OPPOSITE BRANCH OF THE CURVE as is shown by passing from A to C in Fig. 3.

The point C so obtained gives by its abscissa the value of $\frac{\dot{v}}{v}$ at $v_2$.

If the side is entered with a negative $\dot{v}$ the same construction applies. In fact the side must then be traversed from 2 to 1. Thus the start has a negative $\frac{\dot{v}}{v}$; $v$ decreases and by (6) $y$ decreases. The point moves down and thus the two cases are alike if 1 and 2 are reversed.

The step down in this case is $\beta \log\left(\frac{-v_1}{v_2 \epsilon^{\pi\alpha/\beta}}\right)$.

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*Combination of turning point and $v = 0$ on same side.*

We are now ready to treat the case in which the system enters a side, passes the point $v = 0$, comes to its turning point, passes the point $v = 0$ again, and finally leaves the side. It is clear that at the beginning $\frac{\dot{v}}{v}$ is negative. The values of $v$ and $\dot{v}$ at the beginning we call $\dot{v}_1$, $v_1$. We choose a value $v_2$ between 0 and the turning point. The diagram then proceeds along A B C D E F (Fig. 3), where

$$A\,B = \beta \log \frac{|\,v_2\,|}{|\,v_1\,|\,\epsilon^{\pi\alpha/\beta}}$$

$$D\,E = \beta \log \frac{|\,v_1\,|}{|\,v_2\,|\,\epsilon^{\pi\alpha/\beta}}$$

or simply along A G F where $A\,G = -2\pi\alpha$

Thus a step down A G F of amount $AG = -2\pi\alpha$ must be made if $v = 0$ is passed twice on a side. It then gives a point F whose abscissa is equal to the value of $\frac{\dot{v}}{v}$ on leaving the side if $\frac{\dot{v}}{v}$ on entering the side is equal to the abscissa of A.

*Case of $v < 0$.*

A comparison of equations (5) and (6) shows that this case is the same as that of $v > 0$ provided the $|\,v\,|$ is used instead of $v$.

We have thus made a complete study of the motion along a side of the polygon. The advantages of the graphical method, however, become most marked when the transition from side to side is discussed.

*Transition from side to side.*

Let us first consider the special case in which $R = 0$. This case contains the most essential features of the problem.

By (4′) $v = V - E$ for this case. Thus, since $V$ and $\dot{V}$ are continuous $v$ and $\dot{v}$ are also continuous, and consequently $\frac{\dot{v}}{v}$ is continuous. Therefore, if the representative curves of two adjacent sides of the polygon are $C_1$ and $C_2$ (Fig. 3), and if on leaving the first side the representative point is at P then on starting on the second side the representative point is Q where PQ is parallel to OY. Thus, in discussing the motion of the system we need not deal with the values of $\frac{\dot{v}}{v}$. It suffices to make the construction for the representative point on leaving a side and then to transfer the point in a direction parallel to OY to the curve of the next side. In such a way we shall follow the motion of the system and we shall find how the steady oscillation is established.

If $R \neq 0$ the construction is a little more complicated. In this case (see (4′)

$$v = V - \frac{E - \frac{a\delta}{b}}{1 + \delta}$$

where

$$\delta = \frac{-\frac{bR}{}}{1 + \frac{R}{R'}}$$

Hence, the boundary condition at the passage between two sides is

$$\left(\frac{\dot{v}}{v}\right)_2 = \left(\frac{\dot{v}}{v}\right)_1 \frac{1 - \frac{E}{V}\,\frac{1 - \frac{a_2\delta_2}{Eb_2}}{1 + \delta_2}}{1 - \frac{E}{V}\,\frac{1 - \frac{a_1\delta_1}{Eb_1}}{1 + \delta_1}} \qquad \ldots\ldots\ldots\ldots \quad (8)$$

where the suffix 1 refers to side 1 and suffix 2 refers to side 2. If $\delta$ is small one can also write

$$\left(\frac{\dot{v}}{v}\right)_2 = \left\{1 + \frac{E}{V - E}\left[\delta_2\left(\frac{a_2}{Eb_2} + 1\right) - \delta_1\left(\frac{a_1}{Eb_1} + 1\right)\right]\right\}\left(\frac{\dot{v}}{v}\right)_1 \quad \ldots\ldots \quad (8')$$

The equations (8), (8′) mean that if $R \neq 0$ the transition between $C_1$ and $C_2$ is made by changing the abscissa of the representative point in the proper ratio and then moving the point down to $C_2$ parallel to OY.

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For convenience of reference in the following illustration the graphical rules are here recapitulated, the three important rules being (b), (d), (e).

(a) Curve is always plotted for positive $\beta$.

(b) Pass from right branch to left branch along horizontal in case the turning point is on the side and $v = 0$ is not on the side. The turning point is on the side if the maximum step down possible is less than $\beta \log \left| \frac{v_2}{v_1} \right|$.

(c) Pass from left branch to right branch by step down of $(-2\pi\alpha)$ if turning point and $v = 0$ are on side.

(d) Remain on same branch of curve if the maximum possible step down is greater than $\beta \log \left| \frac{v_2}{v_1} \right|$; $v_1$, $v_2$ being the values of $v$ at the beginning and the end. It is assumed that $v = 0$ is not between them. Under these conditions step down by $\beta \log \left| \frac{v_2}{v_1} \right|$ in order to get

$$\left( \frac{\dot{v}}{v} \right)_2 \text{ from } \left( \frac{\dot{v}}{v} \right)_1 .$$

(e) If at entrance of side the representative point is on the left branch and if $v = 0$ is on the side, pass from left branch to right branch by step down of $\beta \log \left( \left| \frac{v_2}{v_1} \right| \epsilon^{-\pi\alpha/\beta} \right)$

The meaning of the symbols $\alpha$, $\beta$, $v$ is also restated. $\alpha \pm j\beta$ are the two roots of the quadratic in $\xi$:

$$C L_P \xi^2 + \left[ \frac{L_P}{R} + b (L_P + \mu M) \right] \xi + 1 = 0$$

where $C$, $R$, $L_P$, $M$ are as in Fig. 1, where $\mu$ is the amplification constant and where

$$b = \frac{di_P}{d(V_P + \mu V_g)} ;$$

$v$ is the excess of $V_P + \mu V_g$ over $E_b + \mu E_a$, i.e.,

$$v = V_P + \mu V_g - (E_b + \mu E_a)$$

**Illustration.**

Let the polygon have three sides (I), (II), (III) (see Fig. 4). The curves corresponding to these sides are numbered (I), (II), (III). It is supposed that the numbers are small so that $\frac{\dot{v}}{v}$ is continuous at the passage. Also the point $v = 0$ is placed on the side (II). On II $\alpha$ is positive and on (I) and (III) $\alpha$ is negative.

If the system is started on side (II) with a negative $\frac{\dot{v}}{v}$ given by A its value on leaving (II) is the abscissa of C where C is obtained from A by the step up A B C. Then the system starts on (I) with a positive $\frac{\dot{v}}{v}$. On I the system suffers damping and the absolute value of $\frac{\dot{v}}{v}$ is already diminished at $E$. With this negative value of $\frac{\dot{v}}{v}$ the system traverses (II) again beginning at F, making a step up F G H (FG $\neq$ AB in general). From H the system passes on to (III) from which it emerges at K with the value of $\frac{\dot{v}}{v} = (x)_K$.

The path of the system from there on nearly coincides with the stationary path.

The introduction of a few more sides does not involve any complications because the construction there is the simple one shown in Fig. 3 for the case $\bar{A}$ $\dot{B}$ $A_1$.

The maximum value of $v$ reached on the sides (I) and (III) is obtained from the location of the points P and Q because the difference in the ordinates of P and D gives directly $\beta \log \left( \frac{v_m}{v_{I,II}} \right)$ where $v_m$ is the maximum $v$ and $v_{I,II}$ is the $v$ of the intersection of (I) and (II).

One can design mechanical devices which will facilitate the constructions here discussed. It must be also remarked that instead of plotting $\frac{\dot{v}}{v}$ as abscissae a function of $\frac{\dot{v}}{v}$ could be plotted as long as this will keep the two branches distinguishable.

The author is very grateful to Prof. H. A. Lorentz, Prof. P. Ehrenfest and Dr. Balth. van der Pol for reading the manuscript.

His thanks are also due to the National Research Council of the United States of America, of which he was Fellow while writing the paper.

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# Experimental Wireless Station 2 KU.

By A. J. S.

THE receiving set shown in Fig. 1 is the result of about 18 months' experimenting with various methods of amplification, both high and low frequency. This set now consists of two radio-frequency amplifying valves, with tapped transformers for wavelengths of 200 to 20,000 metres, a rectifying valve, and two audio-frequency magnifying valves, with iron-core transformers. The whole is made up into a panel set with tuning condensers, series-parallel switch, and plugs for high and low resistance telephones. By the aid of six single circuit plugs and sockets, and four switches to valve filaments on panel front, any of the following nine combinations may be used :—

1. One valve detector circuit.
2. One valve detector and one valve audio-frequency magnifier.
3. One valve detector, and two valve audio-frequency magnifiers.
4, 5 and 6. One valve radio-frequency amplifier, with any of above.
7, 8 and 9. Two valves, radio-frequency amplifying, with any of the above.

The tuning inductances consist of honeycomb coils, covering all wavelengths from 180 to 28,000 metres with 0·0015 variable condenser. In parallel with this condenser are two 0·00008 variable condensers for fine tuning. The series-parallel switch, when moved to series position, cuts out the large condenser, and puts the two small condensers (in parallel) in series with the aerial for short waves.

Provision is made by two terminals to use capacity reaction, for loop and frame aerial work, also for grid potential adjustment to rectifying and radio-frequency valves. A potentiometer can be connected to terminals on panel front. The whole set is self-contained, with the exception of batteries and tuning inductance, and not being over weighty it is easily transported, which makes it very useful for demonstrations at club meetings, field days and exhibitions. Good loud signals are received on a 3 ft. frame aerial.

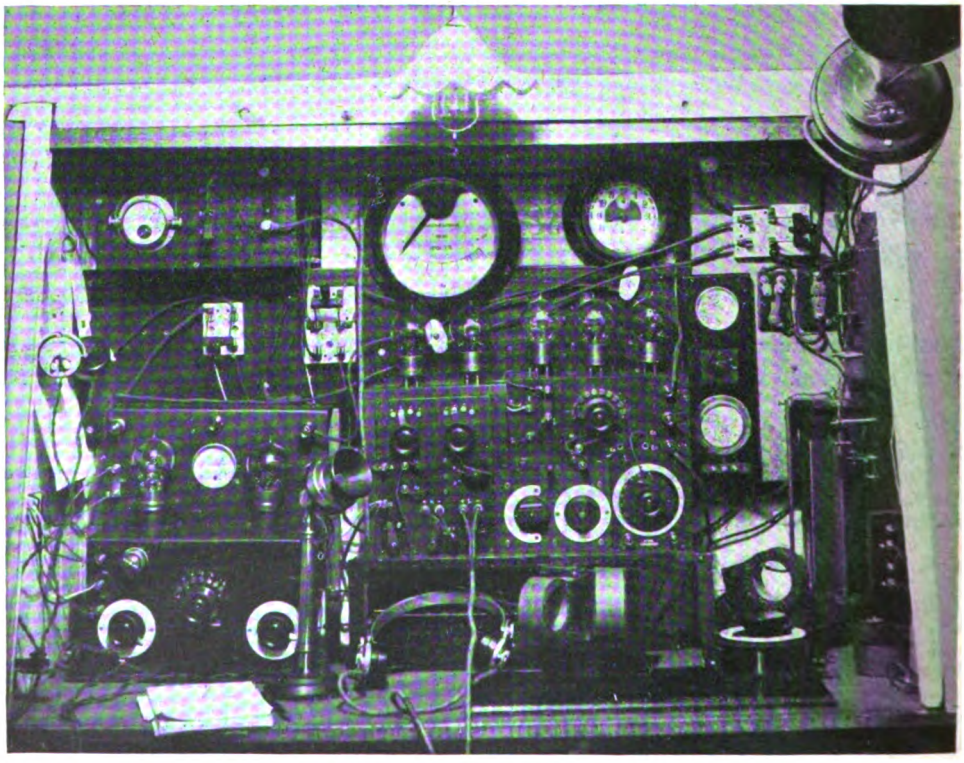

*Fig.* 1. *The Receiving and Transmitting set of* **2 KU**

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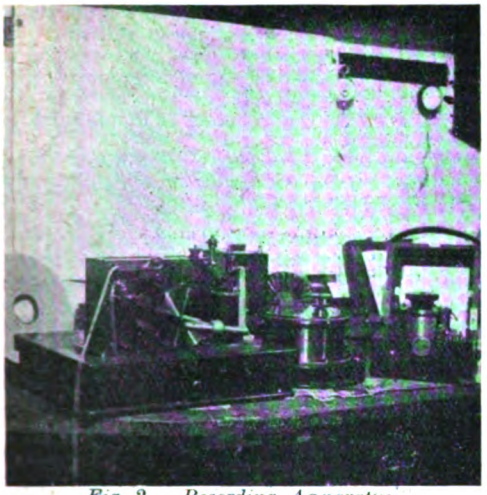

*Fig. 2. Recording Apparatus.*

The recording apparatus shown in Fig. 2 consists of a valve relay as described in *The Wireless World*, January 22nd, 1921, but since altered to the description in the proceedings of the Wireless Society of London in *The Wireless World* of November 12th, 1921, a Siemens relay and Morse inker. On the right will be seen an old Marconi wavemeter, which was reconditioned and its range increased. (The valve relay does not show very well in the photo, being behind the Morse inker.)

The C.W. and telephone transmitter shown on left of Fig. 1 is yet being experimented with, using various methods of microphone control, and on short waves 200 metres and less. The H.T. supply is at present from dry batteries, but an H.T. generator is being constructed from an old aeroplane generator to give about 500 volts D.C.; also it is intended to experiment with the A.C. transformed to 2,000 volts and rectified by valves. On the shelf above, in Fig. 1, will be seen the 180 metres spark transmitter, using an old motor ignition coil. In the right-hand top corner is a Brown's loud speaker; the large voltmeter in centre is for testing H.T. voltage of both transmitter and receiver. The aerial ammeter is in centre of C.W. and telephone transmitter, and the H.T. input ammeter on left.

The other ammeter is the aerial ammeter for spark transmitter. On the extreme right is an old crystal receiver, fixed to side of cabinet, still doing useful service for experimenting with crystal rectification for short waves. The cabinet has a spring roller-blind shutter, to exclude dust while constructional work is being carried on at the work bench. The whole of the apparatus is constructed of more or less junk, the accumulation of over 12 years' wireless and electrical experimenting

# Notes

## Conditions in Norway.

"Radio-activity in Norway seems now at last to have reached the steep part of its characteristic, both government and amateur," says Mr. Kaye Eystein Weedon, Hon. Secretary of the Norwegian Wireless Amateur Club which has a membership of approximately 40. Co-operation with the Petty-Officers' Society at Horten, the base of the Norwegian navy, and with the "Norsk Elektro-teknisk Forening," has been arranged. Amateur working conditions in Norway differ in many respects from those of the British amateur. The British amateur may talk of bad screening from hill 100 feet high some distance away, but what of Kristiania, which is surrounded on all sides but one with what foreigners call mountains, some of which are more than 300 metres in height. And last, but not least, while it was stated somewhere "that but one in a hundred of the British amateurs is so lucky as to have 'juice' installed in his house," it is not too much to say that there will not be more than one in a thousand Norwegian enthusiasts (yet to be, of course), who will have to do without.

The "Telegrafdepartement" is continuing the great work of the late Mr. Ths. Heftye, Director of Telegraphs—the erection of a system of W/T stations throughout the country. LCH, Kristiania, is to be altered for duplex working, and to this end a separate receiving station is to be erected, as is the case with LCM. The few D/F stations that exist are very poor and out of date, bearings being sometimes given which differ up to 100 degrees from the true one. Therefore, when the Government announced that a big modern W/T station is to be erected at Mandal (on the south coast, between Kristiansand S. and Lindesnæs), the Kristiansand Shipmates Society sent the Government a petition, asking that an up-to-date D/F station be at the same time built there.

## Comparative Rates for Transmission.

The difference between the rates charged for transmission of messages by wireless and cable to Australia and India is worthy of note. Under an agreement between the Australian Commonwealth Government and the Amalgamated Wireless, Ltd., the proposed rates are two shillings a word for full rates, a shilling for deferred rates, sixpence for week-end rates, fivepence for press rates and threepence for deferred press rates. These costs are two-thirds of those for cables between Britain and Australia.



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### New Station at Honduras.

About £70,000 is being spent on a contract for the construction of a station near Tegucigalpa, in the Republic of Honduras. Operations will not commence before October, by which time it is expected the station will be in working order, with two towers 458 ft. in height.

### Ocean Depth Sounding.

It is announced by Colonel Theodore Roosevelt, the United States Assistant Secretary of the Navy, that successful tests have been made of a new wireless sounding device, which instantaneously registers ocean depths by measuring the time which a sound takes to travel from the ship to the bed of the ocean and back. The device is an invention of Dr. Harvey C. Hayes, physicist at the Naval Engineering Station, Annapolis. It has just been tested on board the U.S. destroyer "Stewart," during a voyage from Newport to Gibraltar. Over 900 soundings were made, ranging from 2,400 to 28,000 ft.

### Closing of Poldhu.

Operations hitherto conducted from Poldhu, Cornwall, are now being carried out at Radio House, London. Direct transmission to Madrid and Central Spain is now established by the Marconi Company. The new transmission station at Ongar, Essex, transmits to Canada, U.S.A., Central and South America, West Indies, Australasia, etc.

### British Association Meeting.

September 6th has been fixed as the date for the opening of the British Association meeting at Hull. At that meeting exhibitions will be given daily by the Air Ministry of synoptic weather charts and forecasts. Weather data employed will be received from the broadcasting stations in this and other countries, and demonstrations of the reception and of the decoding and charting of the reports will be given by representatives of the Meteorological Office and of the Controllerate of Communications of the Ministry.

The Association is making a great effort this year to secure a fuller attendance of the younger scientific students at the meeting.

### Time and Distance Differences.

Long distance transmitters have to bear in mind the difference in time in various geographical localities. Listening-in messages timed by transmitting stations at great distances must be conducted according to the time at those stations, and not at the time at the receiving stations. As an illustration of this point, a case occurred in which bookmakers in Vienna were discovered to have been accepting bets upon horses run in Paris after the races had taken place. The difference in time between Vienna and Paris was sufficient to allow the arrangement to work successfully.

### Communication with Road Transport.

From the information received from America, which clearly indicates that considerable advance has been made along the lines of adapting apparatus to moving trains for the purpose of telephonic communication, there appears another phase of the same idea upon the horizon. Recently a big

*The apparatus used in ocean depth sounding described on this page.*

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effort was made to so organise road transport that lorries and cars conveying loads on an outward journey might not return empty. It was thought that if some means could be devised of informing the man in charge as to where he could pick up a load for the return journey a tremendous saving would be effected. This scheme, for some reason, has not become very prominent, and the reason is probably that communication is not properly organised. Here is a new field for experiment. While our American friends are perfecting their railway scheme, which is fairly certain, we believe, to mature very shortly with far-reaching results, some enterprising people in this country might be fortunate enough to establish communication with moving transport on the road with equal success.

**Safety Rules and Avoidance of Risk.**

New safety rules to the National Electric Code in America have been adopted. The proposal was made by the National Fire Protection Association, and provide for the protection of receiving and transmitting equipment against lightning effects, avoidance of risk of contact with neighbouring electric light and power circuits, and protection from effects of high potential surges in the lines supplying power to the equipment, as well as the ordinary requirements of sound construction. In the case of receiving equipments, a lightning arrester is required where the leading-in wire enters a building and, on account of the larger size of the ordinary transmitting aerial, which is more likely to be subject to damage from lightning, and the high voltages produced in the apparatus, the provision is recommended in transmitting stations of a double-throw switch for connecting the aerial either to the transmitting apparatus or to earth. The use of this switch is to disconnect the aerial entirely from the transmitting apparatus. On account also of the difficulty which has been experienced by the induction of voltages in the supply lines of a transmitting station, it is advised to use a protective device across the power line near its point of entrance. Copper-clad steel wire is recommended throughout as an alternative to copper wire.

**Suggested Sale of Apparatus by Methodists.**

A suggestion is made in the *Methodist Recorder* that the Sunday School Department of that body should sell apparatus for the installation in Mission Halls and for use in Methodist meetings. The need for broadcasting the principal discussions at conferences for the benefit of Methodists who cannot attend was expressed.

**Cardiff Technical College Apparatus.**

At a recent meeting of the Cardiff Technical Institute Committee, Mr. Charles Coles said in regard to the question of the disposal of the wireless apparatus at the Technical College of which he was Principal, that he recommended its retention for the existing departments of the college. He said it should be placed in charge of the head of the engineering department. The apparatus, in view of the decided impetus given to the study of wireless by the proposal to make Cardiff one of the provincial broadcasting stations, would be available for popular lectures.

**Wireless Broadcasting.**

It is reported that the Cabinet has approved a recommendation of the Postmaster-General that for a period of two years licences for wireless broadcasting should contain a provision that only British instruments should be used.

# Calendar of Current Events

**Saturday, July 22nd.**

MANCHESTER WIRELESS SOCIETY.

2 *to* 3 *p.m.*, also 7 *to* 9 *p.m.*—At Rusholme Public Hall, Manchester. Two lectures on "Broadcasting." Open to the public.

**Sunday, July 23rd.**

Transmission of Telephony from 3 *to* 5 *p.m* on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, July 25th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, mear Chelmsford.

**Thursday, July 27th.**

RADIO EXPERIMENTAL ASSOCIATION (NOTTINGHAM AND DISTRICT).

Meeting.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

LIVERPOOL WIRELESS SOCIETY.

Meeting.

HACKNEY AND DISTRICT RADIO CLUB.

8 *p.m.*—At 111, Chatsworth Road, E.5., Meeting.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Three Circuit Variometer Tuner," by F. E. Studt.

**Sunday, July 30th.**

Transmission of Telephony from 3 *to* 5 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, August 1st.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I would be much obliged if you could enlighten me as to who **5 HD** is. He was calling **5 CO** and sent out some music, and read several passages out of a book. **5 CO** did not answer. This was about 10.30-11.30 one morning just lately. His call letters are not in your latest list, and his wavelength was about 370-400 metres.

G. V. PRIESTLEY.

*3rd July*, 1922.

# Books Received

NATIONAL PHYSICAL LABORATORY REPORT FOR THE YEAR 1921 (London: H.M. Stationery Office. Pp. 207. Illustrated. Price 6s. 6d. net).

RADIO ENTERS THE HOME. A Descriptive Catalogue. (Radio Corporation of America, Woolworth Buildings, New York. Pp. 128. 11" × 8")



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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Brighton Radio Society.*

Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton.

At a recent meeting of this Society an interesting discussion ensued, during the course of which the methods of short wave reception were considered. Various useful suggestions were offered by different members who were present, and it was ultimately suggested and decided upon that at the next meeting all members who so desired should bring their short wave sets along for trial with a view to comparing results.

As a means of assisting the beginner as far as possible in the construction of a set capable of attaining the best possible results at the minimum cost, Mr. Magnus Volk, Vice-President of the Society, very kindly offered to provide the funds for the construction of a set upon these lines, which should be used solely for the assistance of members on the lines indicated.

Everything possible is being done to meet the needs of the amateur in this Society and it is sincerely hoped that gentlemen wishing to obtain a knowledge of the science will avail themselves of the facilities which are now being offered by the Society.

Any gentlemen interested are invited to communicate with the Hon. Secretary.

### North Middlesex Wireless Club.*

The 94th meeting of the Club was held on Wednesday, June 28th, at Shaftesbury Hall, Bowes Park. In spite of the inclement weather, there was an excellent attendance. The chair was taken by the President, and after a few preliminary remarks, he called on Mr. W. Gartland to deliver his paper entitled "The Miscellaneous Applications of the Thermionic Valve."

Those of the members who have heard Mr. Gartland on previous occasions were anticipating something interesting, but all were surprised to hear the very good and consistent results obtained by Mr. Gartland on apparatus which he had just brought to the Hall, and had had very little time to adjust. Anyone who has had the unpleasant experience of bringing a lot of instruments for a lecture, and has failed to produce the results intended will the more readily understand how gratifying it is to be able to record that Mr. Gartland's experiments did *not* fail, but were a great success.

The chief instrument was an altered Mark III receiver, and by means of an ingenious barrel contact switch either one, two, or three valves could be used as desired. This enabled the lecturer to show the valve being used for detecting and amplifying. Speech and music was received, from several stations, and by means of a simple loud speaker was rendered audible to all present.

Unfortunately the time passed so quickly that Mr. Gartland was unable to go fully into the many other uses of the valve, but the brief outlines which he gave were sufficient to show that the applications of the thermionic valve were only just beginning to be realised. The members will look forward to hearing Mr. Gartland again at an early date.

Particulars of the Club may be obtained from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, N.21.

### Croydon Wireless and Physical Society.*

A meeting of the Croydon Wireless and Physical Society was held on Saturday evening, July 1st, 1922, at the Central Polytechnic, Croydon.

Although the attendance was not so large as usual, this was more than compensated for by the enthusiasm of the members present. Mr. A. H. Peakman, a member of the Society, very kindly provided two buzzer sets for Morse practice, and the members divided into two groups, one consisting of the more advanced Morse readers who practised high speed work, and the other of the less experienced gentlemen who were desirous of improving their Morse reading.

After spending a profitable hour, the members had an informal talk on innumerable radio subjects, ranging from the harmonics of GBL to the date on which broadcasting would commence, these subjects in particular calling forth some forcible remarks. The meeting terminated with a vote of thanks to Mr. Peakman for the loan of his instruments.

The Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley, wishes to announce that there will not be a meeting of the Society in August, the next meeting being held on Saturday, September 2nd. He will be glad to hear from any lady or gentleman who may be desirous of joining the Society.

### Stoke-on-Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of the Stoke-on-Trent Wireless and Experimental Society on Thursday, July 6th, some buzzer practice for the benefit of the new members was followed by a lecture on "A Short Wave Tuner," by Mr. A. H. Wilson.

The lecturer, after outlining points concerning wireless receiving sets as a whole, which, if neglected, would greatly reduce the efficiency of any tuner, dealt with the construction of a short wave tuner, on which telephony from local amateur stations and the wireless concert sent out from the Marconi station in Essex could be received with excellent results.

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A home-made tuner of the variometer type, constructed by the lecturer, other tuners and a large number of tuning coils, were exhibited and handed round for inspectoin.

Mr. Wilson was heartily applauded, and the lecture greatly appreciated by the members, who showed their keenness by plying the lecturer with a large number of questions.

### Newcastle and District Amateur Wireless Association.*

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

At the Annual General Meeting, held on July 3rd, the following officers were elected for the ensuing year :—President, Dr. Smallwood, Gateshead ; Chairman, Mr. G. Dixon, Rowlands Gill ; Secretary, Mr. C. Bain, Newcastle ; Librarian, Mr. Fabian, Newcastle ; Technical Committee, Mr. White, Radio Communication Co., Newcastle ; Captain Stevens, Newcastle, Mr. Douthwaite, Newcastle.

The financial statement for the last year showed a balance in hand of £2 1s. 3½d. This is satisfactory, when an expenditure of £17 for new instruments is allowed for. A voluntary subscription collection box yielded £4 11s. 1d. for the twelve months.

The list of members showed 56 up to June 30th. A number of fresh applications have since been received.

A lively debate on the question of entrance fee resulted in the following agreement :—Entrance fee, 5s. ; subscription, 7s. 6d. per annum ; junior members' subscription, 3s. 6d. ; country members, 5s. ; junior country members, 2s. 6d.

A number of elementary and advanced lectures for the winter months are now being arranged.

Those desirous of joining the Society should write to the Hon. Secretary.

*Listening-in on Mr. R. Carlisle's amateur set at Glasgow. The owner is a member of the Glasgow and District Radio Society.*

### Plymouth Wireless and Scientific Society.

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

On Saturday, July 1st, the Society gave a demonstration and exhibition of wireless apparatus at a fête and carnival held at Torpoint. With an improvised aerial and a six-valve set belonging to the Hon. Secretary, quite good signals were obtained, and with apparatus brought by Mr. Graves, an interesting and instructive exhibition was arranged. Very inclement weather was responsible for the non-arrival of much apparatus that would otherwise have been on show, but nevertheless the demonstration was in every way a success and added a substantial sum to the total receipts of the fête.

Although membership has increased considerably during the last few weeks, there is still plenty of room for more members, and particulars of the Society will be gladly furnished by the Hon. Secretary.

### Newport and District Radio Association.

Hon. Secretary, Mr. E. R. Brown, M.S.A., A.T.P.I., 92, Corporation Road, Newport, Mon.

A public meeting was held at the Technical Institute on Thursday, June 29th, 1922, for the purpose of reviving the pre-war activity of the local Association. The meeting was exceedingly well attended and much enthusiasm shown. The following officers were chosen :—*President* : Rt. Hon. Lord Tredegar. *Vice-Presidents* : Sir Garrod Thomas, M.D., Sir Frederick Mills, Bart., Captain C. H. Bailey, Alderman Dr. J. McGinn, Mr. D. W. Roberts. *Hon. Secretary* : Mr. E. R. Brown, M.S.A., A.T.P.I.

Alderman Dr. J. McGinn gave a very interesting and witty address, which, being non-technical but covering useful ground, was very much appreciated by all present.

The membership even now is over 100 and only one meeting has been held. It is hoped to make it the largest Association in Wales.

### Bishop's Stortford and District Amateur Wireless Association.

A meeting of the above Society was held on Friday evening, June 23rd, at 2, Half Acres, Bishop's Stortford, the Vice-President, Councillor E. F. Cooper, in the chair. The President, Mr. W. A. Field, delivered an address entitled "Wireless During the War." This was based chiefly upon his own experiences and observations as a naval wireless officer and a pre-war amateur. His address was full of technical and historic interest and threw an entirely new light upon many of the well-remembered incidents of the war, in which wireless played such an important part.

The lecture was followed by questions and an informal discussion, after which a hearty vote of thanks terminated the proceedings.

Buzzer practice is held every Monday at 8 p.m. and an elementary class for beginners half an hour earlier.

Prospective members should communicate with the Secretary, Mr. J. Cooper, 2, Half Acres, Bishop's Stortford.

### Derby Wireless Club.

The usual weekly meetings will be held at "The Court," Alvaston, on Thursday evenings at 7.30 p.m.

In order to assist the large number of new members recently elected, the following programme, specially suitable for beginners, was arranged :—July 6th, lectures on "The Aerial and its Construction," by Mr. J. Lowe ; July 13th, "Aerial Oscillatory Circuits," by Mr. S. J. R. Allwood ; July 20th, "Detecting Devices," by Mr. E. V. R. Martin ; July 27th, "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

This series will be extended, and additional papers arranged week by week.

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Annual subscriptions due are requested by the end of this month.

The bye-law passed at the Extraordinary General Meeting held on June 22nd last, fixing an entrance fee of half-a-crown for all new members, operates from July 1st, 1922.

Hon. Secretary, Mr. R. Osborne, The Limes, Chellaston, Derby.

### Stockton-on-Tees and District Amateur Wireless Society.

Hon. Secretary, Mr. W. F. Wood, 4, Birkley Square, Norton, Stockton-on-Tees.

A general meeting of this Society was held in the Jubilee Hall, Stockton-on-Tees, on Thursday, June 22nd, which was attended by a large number of members. This Society, which is only a month old, is one of the largest in the district, having close upon eighty members.

Permanent rooms have been taken in the Malleable Workmen's Institute, Norton Road, together with the monthly use of the large concert hall, in which it is proposed to hold lectures, etc. An aerial is being arranged for and considerable apparatus has been placed at the disposal of the members.

The Committee have arranged that some official shall be in attendance in the rooms every evening to cater as much as possible for the wants of the members and also their comforts. The fees have been fixed as low as possible and can easily be met by any working man. The membership is open to persons of both sexes and any age.

The general meetings of the Society are fixed for the second Thursday in every month.

### Dublin Wireless Club.

A general meeting of the Dublin Wireless Club was held at the Central Hotel, Dublin, on Tuesday, June 6th, when a large number of members and prospective members were present.

The Club, which was founded in 1913, did good work previous to the war, but owing to Post Office restrictions on experimental wireless, has been in a more or less dormant state since August, 1914.

In view of the removal of these restrictions, it is now being reconstructed and gives promise of great success. The Committee is engaged in redrafting the Rules, arranging a programme and other necessary preliminary duties.

Another general meeting will shortly be held, when the recommendations of the Committee will be submitted and officers elected for the coming session.

It is hoped soon to obtain more suitable headquarters, where up-to-date instruments may be installed, meetings held, etc.

Persons desirous of becoming members should make early application to Mr. A. C. Bridle, the Hon. Secretary, 29, South Anne Street, Dublin.

### Ipswich and District Wireless Club.

Hon. Secretary, Mr. F. T. G. Townsend, 46, Grove Lane, Ipswich.

A successful field day was carried through on Saturday, June 24th, when by kind permission of Mr. Taylor, of Messrs. Crane Bennett, Ltd., a party of about twenty erected two sets in the field belonging to that firm at Nacton Road. The Club set was tacked on to an aerial attached to a high flag-mast and another set, kindly loaned by Messrs. Boddey, Keeble and Page, gave excellent results on a wire supported by a kite. Mr. Barbrook superintended the arrangements in the unavoidable absence of the Secretary and Assistant Secretary. Transport of the apparatus was effected by means of cars belonging to Mr. Kersey and Mr. Barbrook, to whom the Club is much indebted. The winter programme is now being arranged and any members willing to give lecturettes during the winter are requested to communicate with the Secretary. Also a night is being set aside in the near future for an exchange and mart of members' spare apparatus. All particulars are obtainable from the Secretary.

*Ipswich and District Club's portable set used during a field day.*

The Club now musters nearly 60 members and is looking forward to a first class winter programme. A fair number of experimenters in the surrounding districts have enrolled but are very quiet. However, there are several stations under observation and the owners can be sure of a hearty welcome at headquarters any meeting night.

### Liverpool Wireless Society.

A meeting of the Society was held on Thursday, June 22nd, when an informal exhibition of apparatus was held. Mr. Balmer continued his elementary lectures for beginners.

Mr. A. L. Lyon exhibited a German valve panel and explained its peculiarities. Mr. Vere-Smyth exhibited a single valve home-made set, which was very well made considering that Mr. Smyth is new to the science. Mr. J. H. Swift then brought his home-made three-valve set into action. The results were remarkably good; in fact they were probably the best the Society had ever had at any of its meetings. The set is wired up to Mr. Swift's own diagram and he uses special transformers and not the usual ex-Army type. Music from local stations was audible in the corridors outside and the clearness was remarkable.

A vote of thanks to Mr. Swift and the other exhibitors concluded the meeting.

At a Committee meeting it was decided that Mrs. Skelden, being the first lady candidate for admission, be admitted as a hon. member.

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There will be a meeting of the Society on July 27th.

Hon. Secretary, Mr. James K. Wilkie, "Avondale," Knowsley Road, Cressington Park, Liverpool.

### Cardiff Y.M.C.A. Boys' Radio Club.

The Boys' Department Radio Club at the Cardiff Y.M.C.A. has now a membership of nearly thirty. This Club is open to boys between the ages of 13 and 18 years. Lectures, classes and special training courses are run during the winter months, and the usual activities during the summer.

Secretary for the department, Mr. N. Craven, Whitehead Club. Call letters, 2 UN.

### The Hornsey and District Wireless and Model Engineering Society.

A meeting of the above was held on Tuesday, July 4th. Although this Society is now only a few weeks old and no proper apparatus has been installed, a set was "rigged up" and the concert from Chelmsford clearly heard.

Mr. H. J. Pugh demonstrated a two-valve resistance capacity set, the only aerial used being one of the members standing on an insulated pedestal with one finger on aerial terminal. Messages were clearly heard and readable, many stations being heard.

In future meetings will be held at 29, Felix Avenue, Western Park, Crouch End.

Many interesting features are promised, including elementary lectures for beginners. New members will be heartily welcomed. All particulars from the Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

### Streatham and Norbury Radio Club.

Monday, July 3rd, was the opening day of this Club. For the time being the headquarters will be the premises of Messrs. R. Woodruff & Co., 550, Streatham High Road, S.W.16. It is hoped that in the near future a hall or other suitable club-house will be found.

Several first-class telegraphists have already joined and it is hoped that amateurs, experimenters and other enthusiasts perhaps more advanced, will bring their respective experiences to the Club for mutual enlightenment. The sole idea of the Club will be to fit out a laboratory where members can experiment and construct a complete station.

Application for membership should be addressed to Mr. F. J. Lock, 548, High Road, Streatham.

### Stratford Radio Society.

Hon. Secretary, Mr. R. Singleton, 159, Plaistow Road, West Ham, E.15.

The Society was formed on June 11th with temporary headquarters at the address given above. Prospective members living in the district are invited to communicate with the Secretary, who will furnish all particulars. The area from which the Society hopes to recruit its membership is the Eastern suburbs of London. Experts and novices will both be welcomed.

Gentlemen who might serve as Vice-Presidents are being asked to make themselves known and the Secretary will be glad to receive names as early as possible.

### Ilkley and District Wireless Society.

Hon. Secretary, Mr. E. Stanley Dobson, "Lorne House," Richmond Place, Ilkley.

A meeting was held at the Regent Café, Cowpasture Road, at 7.30 p.m. on Wednesday, July 5th, with Dr. J. B. Whitfield, President, in the chair.

Following the reading of the minutes of the previous meeting, the Committee were elected. It was decided to hold future meetings on the second Thursday in the month, and to arrange a series of practices in Morse.

The Chairman then called upon Mr. H. G. Evans, B.Sc., to give his lecture on "Radio-Telegraphy and Telephony."

The lecturer dealt briefly with the properties of the thermionic valves, and its application to simple wireless circuits. The lecture was illustrated with lantern slides, among which were representations of some of the British high power stations.

After the lecture Carnarvon, Leafield, etc., were tuned in on a very fine set which the lecturer had brought with him.

Unfortunately, the telephony which was expected did not come through, on account of a slight misunderstanding as regards the time.

At the conclusion, a hearty vote of thanks was accorded to Mr. Evans, and the audience, which comprised a large number of visitors, including several ladies, adjourned to inspect the apparatus used by the lecturer.

Twelve new members were enrolled. The Hon. Secretary will be pleased to hear from anyone interested, and will furnish particulars of membership, together with the objects of the Society, on application to the above address.

### Heckmondwike and District Wireless Society.

Hon. Secretary, Mr. F. Townsend, Secondary School, Heckmondwike, Yorks.

A meeting of the above Society was held on Friday, June 30th, when Mr. Dennison, of Halifax, gave a lecture on "Short Wave Reception." Mr. H. Rayner presided over a large attendance.

The lecturer gave a large number of diagrams, showing the connections for different circuits, and also gave a number of valuable hints to amateurs in the construction and manipulation of their own sets.

During an interesting discussion, the lecturer showed a wide knowledge of both the theoretical and practical sides of the subject.

The lecture was illustrated by a fine series of lantern slides, showing the different sets used by Mr. Dennison during the war and since. A hearty vote of thanks was accorded the lecturer.

### Brondesbury and Cricklewood Radio Club.

Hon. Secretary, Mr. J. F. Stevens, 119, Fordwych Road, Brondesbury, N.W.2.

The above Club has been misnamed the "Cricklewood and Brondesbury Radio Club." This is likely to cause confusion unless the title is correctly noted. In all communications the title Brondesbury and Cricklewood Radio Club should be used.

### Central London Wireless Society.

Hon. Secretary (pro tem.), Mr. Horace E. Hobbs, 15, Rydon Crescent, E.C.1.

Inner London enthusiasts are informed of the formation of this new Society in Central London. The Secretary will be glad to hear from anyone interested as early as possible. There is to be a preliminary meeting and the date is not yet fixed. It is hoped that as many as possible will attach themselves in time to attend in order to discuss proposed rules, etc., and to decide upon the organisation.

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**Southampton and District Wireless Society.**

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A general meeting of the above Society was held on Wednesday, June 28th, at the Kingsland Assembly Rooms. A good attendance was recorded. Mr. W. H. Stockdale was the lecturer for the evening. He devoted the whole evening to the Armstrong regenerator short-wave tuner. He also stated the result he himself had obtained from an Armstrong short-wave set amateur-constructed. The lecturer used the blackboard a great deal, much to the liking of the members. At the conclusion of the lecture questions were asked and answered to the satisfaction of the members and a hearty vote of thanks was accorded Mr. Stockdale.

Owing to the large number applying for membership and not yet having obtained licences, the Society now welcomes Associate Members, and particulars can be obtained from the Hon. Secretary. Anyone in the district intending to adopt wireless as a hobby should join the Society and obtain information before buying sets (such as crystal sets for telephony). By so doing they may save themselves from much labour in vain and unnecessary expense by consulting with fellow experimenters.

A general meeting of the above Society was held on Wednesday, July 5th. It was reported by the Secretary that all the amateurs in the Southampton district (with the exception of a few) are members.

The Society will shortly be announcing a further public demonstration, and a pleasant evening is being looked forward to. This demonstration will be given for the benefit of the future wireless enthusiast.

The members are getting very keen on making and constructing their own sets, and not only assembling. Members have been complaining of late of the inability of the local tradesmen to supply them with component parts, and it is now stated that satisfactory arrangements have been made whereby members can obtain all their requirements from their Society. This will avoid further disappointments.

Any one in Southampton interested in wireless and who has not yet purchased or made his set, and would care to have a demonstration of an amateur set, is invited to make arrangements with the Secretary. His station is the most powerful one in the Southampton district, being converted so as to employ 3, 5. 7, 8 or 9 valves at discretion. Mr. Freeman, the Chairman, has also a very powerful receiving station, using 7 valves, and he also will oblige any amateur interested.

**The Hackney and District Radio Society.**

The third meeting of the above Society took place on June 22nd at 111, Chatsworth Road, Clapton, at 8 p.m. There was again a good attendance. New members continue to come in.

After the minutes of the previous meeting had been read, the Rules and Regulations were again read and confirmed. Now that the Society is well established, an endeavour is being made to build up an interesting programme for the quarter.

Public meetings were held on the 6th and 7th of July. The lecture given at the opening by Mr. E. R. Walker was on the "First Principles in Wireless Telegraphy," showing the audience how the aerial became charged so that it produced waves, and so opened up the present-day means of long-distance communication. After seeing that the audience had more or less grasped the situation, the second lecturer, Mr. D. R. Ison, gave an explicit explanation of reception of these waves, with the aid of a Marconi 31 A tuner. This was followed by a great number of questions being asked by a greatly interested audience and many points were touched upon, including construction of many portions of apparatus. During the evening various items of telephony were received. Many thanks were given for the loan of a Brown loud speaker.

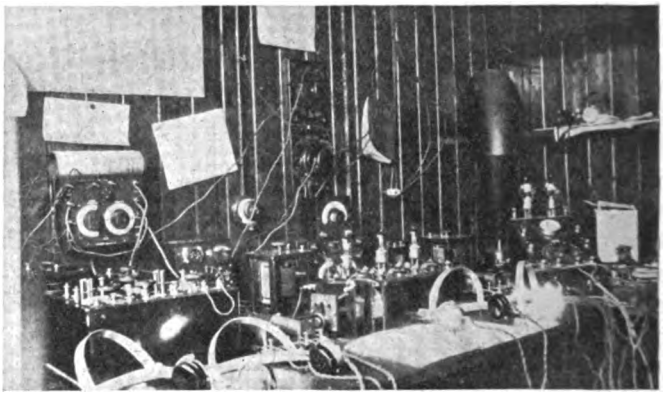
By these means the Society hopes to increase the numbers of its members and make itself popular throughout the Hackney district.

The apparatus which was used consisted chiefly of units made by members, who have gained excellent results with amateur-made apparatus.

Membership has greatly increased, being now over 40, and the Society will soon be looking for a more convenient meeting hall for permanent headquarters. Meetings are held every Thursday.

All enquiries as to membership, etc., should be made to the Secretary, Mr. E. R. Walker, 48, Dagmor Road, South Hackney, E.9.

**Loughborough College Wireless Society.**



*The Society's Receiving Apparatus.*

**Barnoldswick Wireless and Technical Society.**

A Society bearing the above name has been formed in Barnoldswick (Yorkshire) and there is every promise of rapid development. The prime object of this Society will be the study of wireless as a science.

The Society is commencing work with a course of progressive lectures in theory and practical construction. These lectures will be augmented by a special class in practical physics and applied science.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, The Wireless World and Radio Review, 12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"J.D." (Lancaster)** *asks* (1) *If he can receive* **PCGG** *and* **2 MT** *on a Mark III long wave tuner and three-valve amplifier. His aerial is* 138 *ft. long and highest point* 48 *ft. high.* (2) *For windings for a telephone transformer for use with* 120 *ohm telephones.* (3) *Wavelength of Mark III long wave tuner.* (4) *Windings and former for reaction coil for Mark III long wave tuner.*

(1) Yes, you should be able to get both these stations, presuming of course that you can tune down to 400 metres. (2) See page 343, June 17th issue, winding to a diameter of 11/16" with No. 46 S.S.C. for the primary, and up to a diameter of ¼" with No. 40 S.S.C. for the secondary, spacing the cheeks 1⅜" apart instead of 1" as given in the diagram. (3) Probably about 7,000 metres. (4) It is difficult to incorporate a reaction coil in this tuner, but owing to the special design of the inductances it is quite easy with a few minor alterations to use the tuned closed circuit to give reaction effects.

**"J.D." (Liverpool).**—(1) and (2) The circuit you show and the dimensions you give of the various components are quite satisfactory. It would be better, perhaps, to arrange a small condenser across the telephones of 0·002 mfd. and a separate condenser of bigger capacity across the high tension battery. Your aerial consisting of six wires each 11 ft. long is not a very good arrangement. (3) You can easily convert your set into one embodying H.F., detector and L.F., and for circuit see page 37, April 8th issue.

**"S.M." (Forest Gate).**—(1) The specimen of the asbestos material cannot be recommended as suitable for the mounting of the components of a valve circuit. (2) You would require about 22 movable and 23 fixed plates to give a capacity of 0·001 mfd. (The delay in answering your queries, occasioned by making tests on the material you submitted, is regretted.)

**"ANATKH" (Southerick-on-Weir).**—(1), (2), (3) and (4) The circuit you show is incorrect, and we would advise you to consult the pages of this journal in which are given scores of reliable circuits. It is doubtful how the valve would function in your circuit, and we cannot see how the set could work at all unless perhaps you have made some mistake in drawing out the circuit.

**"C.P." (Hartly Witney)** *sends a specimen of wire and wishes to know* (1) *Its gauge and covering, and* (2) *If it is suitable for the construction of H.F. transformers.*

(1) 38 S.S.C. (2) Yes, though double silk covering would be better if you have in mind winding primary and secondary simultaneously.

**"——— " (Sittingbourne).**—(1) Your aerial would appear to be quite satisfactory, though read carefully article on aerial construction in May 27th issue. (2) and (3) Your cardboard tubes will be very useful for the construction of aerial and reaction coils, and you would be well advised to saw them up into three portions, each 4" long, and making three tuners for short, medium and long wave tuning. The 6" diameter tube for the aerial coils may be wound with No. 20 D.C.C. for reception up to 650 metres, No. 26 D.C.C. up to 1,200 with parallel condenser and two or four-pile winding of No. 30 D.C.C. for longer wavelengths. The reaction coils, 5½" in diameter, may have windings of No. 22 D.C.C., No. 28 D.C.C. and No. 34 D.C.C. respectively. (4) We consider that it is improbable that you will be able to receive **2 MT** on a crystal in Kent.

**"AERO" (Doncaster).**—It is very difficult to say why you only receive signals when touching certain parts of your circuit. The usual effect of making contact with your receiving circuit is to cause some slight change in tuning and so bring in a particular signal. In your case, however, as the high tension circuit only appears to be concerned, we should imagine that fault is either in the transformer primary or its bridging condenser, which should have a value of 0·002 mfd., and not 0·0002 as marked in your diagram.

**"W.F." (Johnstone).**—It is not possible to advise you as to whether your telephone receivers are suitable for conversion for use with wireless receiving apparatus. High resistance telephones are wound with wire from 46 to 50 S.W.G., according to the dimensions of the pole pieces and the number of turns required. Thinner diaphragms may be required, but without knowing the type at present fitted it is impossible to advise you. Thin diaphragms are not always an advantage, as the stiffness of thicker ones sometimes gives a desirable damping effect, making them operative over a wide range of note frequencies.

**"EMMERESSES" (Dundee)** *asks* (1) *For dimensions of aerial tuning inductances to tune to* 150-800 *metres on a* 4" *former.* (2) *Reaction coil*

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*for same.* (3) *Dimensions for A.T.I. and reaction coils for* 1,500-5,000 *metres.* (4) *Whether a variable condenser of* 0·0015 *mfd. can be used in parallel with these coils.*

(1) Depends on the size of your aerial, but 4 ins. of winding of No. 22 D.C.C. would no doubt be suitable. (2) 3 ins. of winding of No. 26 D.C.C. on a 3" former. (3) A.T.I. 5½" diameter by 7" long, wound with No. 28 D.C.C. Reaction coil 4½" diameter by 5" long, wound with No. 32 S.S.C. (4) Yes; air dielectric recommended.

"**F.T.**" **(Bradford)** *wishes to know* (1) *If fixed condensers may be mounted one over the other in order to economise in space.* (2) *Dimensions and number of plates for building a variable condenser.* (3) *Whether waxed teak can be used instead of ebonite for tuner construction.* (4) *To what purpose he can put* 25/40 *D.S.C. wire.*

(1) Not recommended, as the condensers are bound to have capacity one to another, which, in a valve circuit, may cause trouble. (2) If the plates have an overlap diameter of 2⅜", and are stamped on No. 20 S.W.G. sheet and spaced with washers 5/64" thick, then 30 moved and 31 fixed plates will give a capacity of approximately 0·0015 mfd. (3) We do not advise this unless the room in which your receiving apparatus is installed is a very dry one. (4) Quite useful for constructing inductances for crystal or non-reactive tuners, but little would be gained by the use of this special wire, which is essentially designed to minimise damping, if reaction is to be made use of.

"**ALPHA**" **(Huntley)** *sends circuit similar to that shown on page* 372, *June* 17*th issue, and asks* (1) *If we consider it a good one.* (2) *For values of grid condenser and leak.* (3) *The tuning range of his loose coupler.*

(1) and (2) The circuit is one which gives quite good results, and the values asked for are given in the diagram referred to above. Arrange to connect aerial tuning condenser, which may have a value of 0·001 mfd., in series or parallel with the aerial inductance. (3) Approximately 800 to 4,500 metres, depending upon the dimensions of your aerial.

"**A.W.S.**" **(Mt. Kennedy)** *asks* (1) *If a flat inductance wound on a "spider" is called a slab or a pancake coil.* (2) *Dimensions of intervalve transformers for* 450-4,000 *metres, consisting of such coils of* 100 *turns of No.* 40 *wire.* (3) *Whether lightning discharge would destroy an aerial wire of thinner gauge than No.* 18, *and what precautions should be taken to prevent damage from this cause.* (4) *Whether* 1 *H.F. amplification will give much better results on distant telephony than one stage L.F. amplification.*

(1) Inductances of the flat type are called slab or pancake coils. Those wound on a "spider" are called basket coils. (2) It is difficult to say, but very good intervalve transformers can be made by placing basket coils together, or better still, by winding two wires on the "spider" simultaneously. Do not use transformers for wavelengths above 2,000 metres, as the comparatively large capacity given by the many turns would make their action equivalent to capacity reaction intervalve coupling. (3) The gauge of the aerial wire is controlled by the mechanical strength required. With small amateur aerials there is very little danger of damage by lightning, but a switch should be arranged to earth the aerial when not in use. (4) Yes, H.F. amplification does not increase signal strength to the same extent as L.F. amplification, but H.F. will bring in weak signals which any amount of L.F. would never render audible.

"**T.H.D.**" **(Cardiff)** *asks* (1) *For the name of a publication, if not too technical in character, dealing with wireless telephony.* (2) *Whether any manufacturer of wireless telephony receiving sets rents them out on some such basis as the ordinary telephone.*

(1) There is no publication which deals exclusively with the action of wireless telephony. There are many simple theory books, such as "Wireless Telegraphy," Parts I and II, by Bangay, "Wireless Telegraphy," by Stanley, and for practical constructional details you might read "The Construction of the Amateur Valve Station," by Douglas, or "The Radio Experimenter's Handbook," by Coursey. An introductory booklet to the properties and applications of wireless telegraphy and telephony is "The A.B.C. of Wireless," by Harris (*Wireless Press, Ltd.*). (2) We are not aware of any manufacturer offering sets on these terms.

"**W.B.**" **(Yeovil)** *wishes to make a two-valve receiver, and asks for information as to how to do this.*

A set of this type could be constructed, but would not be very efficient on the low powers and wavelengths used for telephone transmissions. It would give very poor results on long distance telephony, which is only, perhaps, 1/20th of the effective strength of spark signals coming from the same stations. For satisfactory results for 50 miles on a loud speaker from a broadcasting station with an indoor aerial, five or six valves would be required. The life of a good type valve, carefully used, runs from 1,000 upwards to 5,000 hours. Carelessly used it may only last a few hours.

"**RADIO**" **(Hornsea)** *asks* (1) *How to connect a variable condenser with a reaction coil.* (2) *Is a reaction coil of good proportion to the A.T.I., if it has* 4/5*ths of the amount of wire on it.* (3) *If the capacity of a condenser is increased or reduced by enlarged spacing between the plates.* (4) *If* 30 *volts is sufficient for a Mullard "Ora" valve.*

(1) A variable condenser is not essential with a reaction coil, but often quite useful if connected across the coil and having a maximum value of 0·0005 mfd. (2) This figure is often about right, but no hard and fast rule can be given. (3) Large spacing reduces capacity, which is inversely proportional to the width of space. (4) Yes.

"**L.L.**" **(Rainham)** *asks* (1) *For a diagram of connections for a certain set.* (2) *Winding data for set.* (3) *What should be the values of the resistances of the L.F. transformer.* (4) *For criticism of set.*

(1) The combination suggested is not suitable. We should recommend complete connection as in Fig. 5, page 15, April 1st issue, with series parallel switching for A.T.C. if desired. The number of turns might be as follows:—90, 100, 190, 300, 490, 950, 1,800, 2,500, and the total weight of wire approximately 1 lb. (3) Resistances might be 2,000 and 5,000 ohms, with considerable latitude. (4) The set, as we have arranged it, should be quite satisfactory.

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**"R.H.W." (Little Sutton).**—If your receiver is connected as in your diagram we are surprised you have even heard crackling noises, which are due to atmospherics. We cannot say the capacities of your condensers as you tell us nothing about them. Similarly, we cannot say much about your wavelength, but with connections as in Fig. 2, page 120, April 22nd, you should tune in broadcasting stations all right. The loose coupler might be 6″ × 5″ of No. 22, and 4″ × 3″ of No. 28.

**"C.M.B." (Marlborough)** *asks which of three types of aerials would be most satisfactory, and how he could receive* **PCGG** *at Nice.*

An aerial length of 300 ft. is not allowed in this country. Even if you propose to erect the aerial abroad, we think that the second or third scheme would be better, the choice between them lying with the one having the greater height above the roof or earth as the case may be. Reception of **PCGG** at Nice would probably give very severe difficulties, and require at least a six-valve set for any results at all. If you succeed, we should be interested to receive an account of your methods.

**"R.H." (Stoke Newington)** *encloses diagram of his set and asks* (1) *What is its wavelength.* (2) *What stations transmit between 7 and 9 p.m.* (3) *If 100 ft. of No. 16 copper wire would be all right for an aerial.* (4) *The cause of loud whistling in his telephones.*

(1) 2,000 metres without a parallel condenser, and about 4,000 metres with a parallel condenser of 0·001 mfds. (2) See list in issue of August 6th, 1921. It is hoped to publish an amended list early in August. (3) Yes. (4) We could help you more if you told us the circumstances under which the whistling occurred. It is most probably due to too tight reaction coupling.

**"TANKS" (Newcastle-on-Tyne)** *asks* (1) *If a four-valve diagram will fulfil certain specialised requirements.* (2) *Length of aerial required to hear Dutch Concerts and English broadcast stations.* (3) *If cutting out one or two valves will alter the range and strength of signals.* (4) *If it is possible to cut out Cullercoats at a distance of 10 miles.*

(1) See Fig. 5, page 62, April 8th issue, a fourth valve being added exactly as the last valve there shown. (2) Anything between 50 and 100 ft. should be satisfactory. (3) Certainly, otherwise there would be no point in using these valves at all. (4) You are unlikely to cut out Cullercoats on wavelengths close to his own, but at other wavelengths you should be able to do so by sufficiently weakening the coupling.

**"T.R.S." (Stoke-on-Trent)** *gives particulars of his set and asks why he cannot receive telephony.*

The probable cause of failure to receive telephony is the distance from any telephone transmitting station. You would have a better chance with a series A.T.C. rather than a parallel, but we doubt if you will get any success without one or two more H.F. valves.

**"INSULATION" (Winchester)** *asks* (1) *How does an electrolytic detector compare with a carborundum in sensitiveness.* (2) *Could he hear* **FL, 2 MT** *and Croydon telephony on a crystal set with aerial 25 ft. high.* (3) *Who is* **GKB.** (4) *If 110 volt H.T. should be used with an R.5 valve.*

(1) More sensitive, but less reliable. It is difficult to give a numerical estimate of the relative sensitivity. (2) **FL** possibly; **2 MT** very doubtful. (3) Regret we have no information. (4) Yes.

**"S.B.X." (Liverpool)** *asks for a diagram of a two-valve and crystal, or three-valve and crystal circuit, with loud speaker suitable for broadcasting telephony.*

See Fig. 6, page 215, May 13th issue, with the loud speaker in place of the telephones.

**"G.N.N." (London)** *describes his set and asks* (1) *If the reaction coil described will make it suitable for valve reception.* (2) *Wavelength range of the coil.* (3) *Capacity of a certain variable condenser.* (4) *If a single wire aerial 70 ft. long and 25 ft. high, will be suitable for a single valve set.*

(1) No, it will probably be necessary for the reaction coil to slide inside the A.T.I. unless considerably more turns are used. (2) The aerial circuit will tune to about 2,000 metres. The closed circuit probably very considerably higher. (3) 0·00065 mfds. (4) Yes.

**"FOGGED" (Croydon)** *asks for a three-valve set to give best results on all wavelengths.*

Neither of the resistance capacity coupled sets you suggest will be of much use below 1,000 metres. The circuit of Fig. 5, page 62, April 8th issue, would fill your requirements, but the necessity for a larger number of transformers could be avoided by using resistance capacity coupling above 1,000 metres. This can easily be made to plug-in in place of, and be substituted for the normal transformer.

**"PLUS ONE" (Tonbridge)** *encloses diagram of circuit and asks* (1) *How to add one more valve.* (2) *What voltage should the L.T. be for use with "Ora" valves.* (3) *What stations should be heard with basket coils, range 300 to 5,000 metres.*

(1) See the diagram given to **"TRIODE" (West Bridgford).** (2) 6 volts with a 6 ohm resistance. (3) Broadcasting, some ships, air stations and Continental stations, such as **FL.**

**"TRIODE" (West Bridgford)** *wishes to construct a set described in the issue of March 4th, and asks* (1) *Dimensions of a variometer to tune from 450 to 12,000 metres; gauge and amount of wire required for this.* (2) *If a valve panel can be used to connect with set, or the short wave receiver described in the issue of June 3rd.* (3) *If Paris sends out Greenwich time, or must correction be made for the longitude of Paris.*

(1) For a range of this extent you would need a set of interchangeable honeycomb coils with turns ranging from about 50 to 5,000. The mean diameter of coil is about 2½″, and the wire used might be No. 26. (2) The most suitable arrangement for this purpose would be as a note magnifier as in diagram (Fig. 1). (3) No correction is necessary for the longitude of Paris.

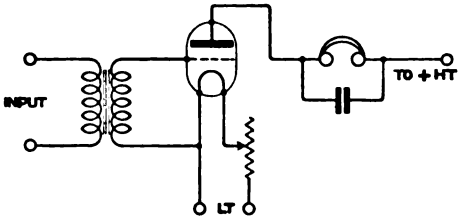


*Fig.* 1.

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**"A.V.B." (Ostend)** *asks for a formula to calculate the self-inductance of a duo-lateral winding such as published in the issue of December 11th.*

There is no accurate formula. That given to **"V. 526" (Australia),** on page 64 of the April 8th issue gives results which are generally within 10 to 15 per cent. of truth.

**"D.H.B.McC" (Leicester)** *asks* (1) *The number of turns and tappings on a* $2\frac{1}{2}'' \times \frac{1}{4}''$ *former to tune to* 25,000λ. (2) *Best values for grid condenser and leak for "Ora" valves in the same circuit.* (3) *For criticism of two methods of connecting the L.T.*

(1) We have no data. Suitable windings would have to be determined by experiment, as the self-capacity of the coils would prevent accurate calculation. (2) Try about 0·002 mfds. and 2 megohms. (3) Almost immaterial. Method 2 is somewhat less liable to lead to cross connections and short circuits in connecting up more than one set to a single pair of batteries.

**"AERIAL" (Reigate)** *sends a diagram of his set and asks* (1) *Which would be the better wire to use for the aerial, 7/22 or 3/18 copper.* (2) *If the circuit sketched is correct.* (3) *What should be the H.T. voltage for two Mullard "Ora" valves.* (4) *Would a condenser across the primary of the H.F. transformer improve results.*

(1) Either will do; 7/22 preferable. (2) Yes, except that the earth end of the A.T.I. should go to the negative of the L.T. instead of to the positive. (3) About 40 volts. (4) Yes, it would increase the effective wavelength of each transformer.

**"T.Q." (Sutton)** *sends diagram of his circuit and asks* (1) *For criticism.* (2) *The most suitable type of tuner to use.* (3) *How to connect the tuner between X and Y.* (4) *If* **PCGG** *will be received on the loud speaker.*

(1) Circuit is O.K. (2) and (3) Arrangement as shown is O.K., or any two-circuit tuner may be used with secondary condenser across X and Y. (4) It should be, with careful tuning.

**"W.D.O'G." (Harrogate)** *asks* (1) *Whether down lead should be taken from the lower or higher end of an aerial.* (2) *Whether down leads may be lashed together round the insulator from which they fall or should pass freely through it.* (3) *If not convenient to get down leads to a suitable room, if loud speaker leads may be run from the receiving room to that in which signals are to be heard.*

(1) Very little difference. It is generally best to take it from the end nearest to the instruments. (2) Leads should be fastened round the insulators. (3) Yes.

**"J.S." (Slaithwaite)** *asks* (1) *For winding data for a H.F. transformer for a range of* 440 *metres.* (2) *Winding data for transformer for* 2,600 *metres.* (3) *If the aerial sketched is suitable for telephony.* (4) *Are four "Ora" valves connected by H.F. transformers sufficient to give good signals with* **PCGG.**

(1) This will need experimental adjustment, but try about 70 turns per winding to commence with. (2) Try 200 turns. (3) Quite suitable. (4) Better to use the last stage as L.F. amplifier.

**"SPARKS" (Harrow)** *asks* (1) *If he could increase the wavelength of a set described in the issue of June 10th, and for winding and connecting details.* (2) *Dimensions of coil described in the issue of June 3rd.* (3) *If enamel can be used for insulating the cardboard formers for inductances.* (4) *If the aerial sketched is correct.*

(1) Try about 90 turns for each coil. The connection is quite simple. Put one end of coil 1 to the aerial and the other end to one end of coil 2, and the other end of coil 2 to earth. (2) A spherical coil of 3″ diameter wound full of No. 20 or 22. (3) Enamel might be O.K., well stoved on, but it would not be easy to do, and we do not recommend it. (4) O.K., but why not just bind the wires with a thinner wire and then solder the whole up.

**"C.A.S." (Reigate)** *sends sketch of his circuit and asks* (1) *The simplest way of altering it to work on lower wavelengths.* (2) *Would this circuit work on lower wavelengths if duo-lateral coils were used.* (3) *Would a separate heterodyne give the required results.*

(1) Put the A.T.C. in series with the A.T.I. (2) No, unless smaller coils were used, but you could make smaller coils yourself. (3) A separate heterodyne will not affect the wavelength range of the set.

**"B.E.P." (Woking)** *asks* (1) *With reference to the article on heterodynes in the issue of May 6th, if the value of C.2 is correct.* (2) *What is the capacity of the telephone blocking condensers on Mark III tuners.* (3) *How to clean an ebonite panel where discoloured by light.*

(1) No; in this case a value as high as this is desirable. (2) Usually about 0·0025 mfd. (3) Rub it up with emery cloth, finishing up with a very fine grade, then polish with a little oil on a rag.

**"E.D." (Bristol)** *asks* (1) *For a diagram of a switching arrangement for a five-valve receiver, so that any combination of valves may be used at once.* (2) *How can he obtain a list of stations transmitting telephony, and if any afternoon concerts are run on weekdays.*

(1) Detailed design of a set of this type is outside the scope of these columns. However, a set of this kind is shown in Fig. 3, page 31, April 1st issue, in which transformers may be used for H.F. coupling if preferred. If transformers are used the switching arrangement may be as in the diagram.

**"STAR" (Romford)** *asks* (1) *What is the best size grid leak and condenser to use with a Mullard "Ora" valve.* (2) *If a Britwire coil is used as a tuner, will another Britwire coil do as a reaction coil.* (3) *What size coil will act as reaction for the* 180/450 *metres coil, a smaller or a larger one.* (4) *If a single valve circuit sketched is suitable.*

(1) About 0·0002 mfds. and 1 megohm. (2) Yes. (3) The best value to use should be found by experiment. Either is suitable at this wavelength. (4) O.K. if you put a condenser across the telephones, but a loose coupled circuit will give much less re-radiation.

**"MICA" (Broadstone).**—(1) Thickness of copper is 1·5 mils., and mica 3 mils. For 0·002 mfds. use five metal foils with an overlap of 5 sq. centimetres. For 0·004, use nine foils with the same overlap. (2) Neither of these cells are recommended, but the Edison type may be used if desired. The disadvantage is change of voltage on discharge. The price comes out somewhat higher than for normal cells. (3) Coil of this type is not suitable for use in this way, except possibly by removing

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the break, exciting the primary by a buzzer, and introducing secondary in the grid circuit of the valve.

**"H.A.W." (Elmhurst Park)** *asks* (1) *For suitable reactance coil 5"×9" of No. 28.* (2) *Wavelength of the above coil.* (3) *Gauge of enclosed wire.* (4) *If a car ignition coil would be any use as a transformer.*

(1) Try 4"×6" of No. 32. (2) Inductance is 14,000 mhys. This will tune a P.M.G. aerial to about 4,000 metres. (3) No. 37. (4) Possibly it could be used as a microphone transformer, but winding is unsuitable for anything else.

**"R.V.S." (Manchester)** *submits diagram of a crystal set and asks* (1) *Values for the variable condensers.* (2) *A question about the connecting up.* (3) *If certain formers will be suitable.* (4) *For criticism of set.*

(1) A.T.C. enclosed circuit condenser 0·0005 mfd. each. Blocking condenser 0·0002 mfds. (2) Preferably to Y. (3) The suggested values should be all right. If you cannot tune down to 325 metres, remove a few turns from the fixed portion of the coil. (4) O.K.

**"J.R.C." (Kilburn)** *asks for a diagram of a single valve set with dimensions for tuning from 180 to 1,100 metres.*

See diagram. Fig. 2.

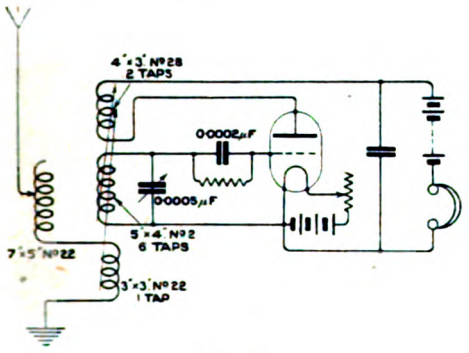


*Fig. 2.*

**"CAT" (Dartford)** *asks whether the fact that a crystal passes current as indicated by a click in the telephones, or the fact that a cat-whisker adjustment behaves as a microphone indicates that the detector is functioning properly.*

No, neither of the tests in any way prove that the crystal is capable of rectifying H.F. currents.

**"RADIO-TRAIN" (Brixton)** *asks what Government licences are necessary to carry out experiments in radio-control of mechanical transport.* (2) *What wavelength he would be allowed to use.*

(1) We think that the ordinary regulations governing transmission would probably apply, but you should apply to the Post Office for detailed information. (2) This would have to be settled with the Post Office. They might agree to the normal amateur wavelength, or more probably a lower value, say 20 to 50 metres.

**"G.H.I." (Highgate).**—Coils suggested could be used. Reaction coil might be 6"×3½" of No. 28, introduced into the closed circuit coil of the end farthest from the A.T.I.

**"J.F.S." (Hoylake)** *describes a proposed aerial, and asks* (1) *Which of two arrangements is the better.* (2) *What is a suitable earth.* (3) *If an iron tube mast is as good as a wooden one.* (4) *If the length of the supporting rope affects the aerial.*

(1) Impossible to say without tests or detailed sketch of the two arrangements, but the higher aerial would probably be somewhat the better of the two. Try the aerial to the dormer window to start with. (2) A buried plate, 3 ft. square, or fine mesh netting on the ground, not less than 12 square yards. (3) O.K. (4) No, except for liability to tighten up in wet weather.

**"D.C.M." (Dublin)** *has a set which works on a crystal but not on a valve, and asks why this is.*

Impossible to say. Possibly the valve is defective. However, some of the circuits referred to are of doubtful utility. See Fig. 3.

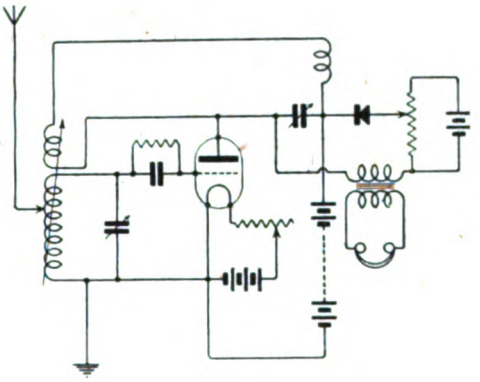

*Fig. 3.*

**"CAREFUL" (Derby)** *asks* (1) *For criticism of a circuit sketched.* (2) *If a set of slab inductances 300/30,000 metres would be suitable for the A.T.I. of his set.* (3) *Would the circuit be suitable for short-wave telephony, using the aerial sketched.*

(1) Circuit O.K., but interchangeable H.F. transformers will be required to cover a wide range. (2) Yes. (3) Yes, with A.T.C. used in series.

**"POMPONIAN" (Portsmouth)** *gives a diagram of his circuit and asks if it is correct, and various details about it.*

Circuit is O.K. For the A.T.I., 8"×6" of No. 22; Coupler, 3"×2" of No. 22; closed circuit coil, 6"×4" of No. 28; closed circuit condenser, 0·0005 mfds.; grid condenser, 0·0002 mfds.; anode blocking condenser, 0·001 mfds.

**"SHAFTESBURY" (London)** *sends a sketch of a three-valve amplifier, and asks* (1) *If the wiring diagram is correct.* (2) *If a list of components for an amplifier are correct.* (3) *Particulars of suitable aerial, A.T.I. and reactance coil.* (4) *If this set will receive telephony and broadcasting concerts.*

(1) Yes. (2) The grid condenser is too big. Two pieces should be enough. The plates of your condenser are probably too big. (3) The A.T.I., 8"×6" of No. 22. Reaction coil, 5"×3" of No. 28. (4) Yes, from stations in the London district.

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**"FRAME" (Halifax)** *asks* (1) *Formula for calculating the inductance of Lokap wound coils*; (2) *If the P.M.G. has officially allowed experimenters any length of aerial.* (3) *Size of condenser across telephones.* (4) *Particulars of a French wireless magazine, and if it would help an experimenter in this country.*

(1) There is no very good formula. That given to **"V. 526" (Australia)** in the issue of April 8th, page 64, is about the best. (2) No increase of length is to be allowed, except in the case of a multi-wire aerial, where the length may now be brought up to 100 ft. as with a single wire. (3) About 0·001 mfds. is a very good value. The value suggested is probably lower. (4) It would probably be of interest, but it is doubtful if it would be of any very great help to you.

**"BEGINNER" (N.W.8).**—(1) and (2) There is no point in making a crystal set to tune above 3,500 metres, as there are no spark stations above this wavelength for it to work on. If you must have a greater wavelength, increase the closed circuit capacity and put the A.T.C. in parallel with the A.T.I. (3) Tappings or a slider may be used if good variable condensers are available. If the condensers are not continuously variable a slider must be used.

**"C.L." (Maldon)** *refers to the Reinartz Tuner, described in the issue of May 13th, and asks* (1) *What is the maximum and minimum wavelength on a P.M.G. aerial.* (2) *What would be the approximate cost to make.* (3) *If a certain loose coupler and reaction would be suitable for the broadcasting and amateur telephony.* (4) *The reason for humming noise when the hand is put near the valve.*

(1) Approximately 200/450 metres. (2) It depends on whether the variable condensers, switch knobs, terminals, etc., are made or bought. If every part is made, the set could possibly be made for 20s. or 30s. excluding the valve. If the parts were bought, and only the set assembled, the cost might be upwards of £5. (4) We cannot say without test.

**"JOB" (Manor Park).**—The gauges of the samples of wire are as follows:—1, No. 24; 2, No. 22; 3, No. 21; 4, No. 28.

**"B.E.J." (Copenhagen)** *encloses a diagram of his set and asks* (1) *How to make R oscillate regularly without altering the coils or H.T.* (2) *Which valve will generate most, and how many watts will each deliver to the aerial.* (3) *Wavelength range for telephony and telegraphy.* (4) *Would results be better with 220 volts H.T. with a 25 watt transmitting valve intended for 800 volts H.T.*

(1) Put the condensers across the key or microphone contacts, or put a static potential on the grid, or use a grid condenser and leak, or alter the size and position of the reaction coil. (2) Approximately the same. Probably not more than one watt. (3) Difficult to specify. Possibly five to ten miles with critical reaction. (4) Probably, although it may be somewhat difficult to induce it to oscillate on so greatly reduced voltage.

**"H.R." (The Hague)** *encloses a diagram of his set and asks for criticism and an improved diagram.*

The set is of quite good type, except that there is rather too little L.F. and too much H.F. amplification. Try the circuit of Fig. 3, page 467, July 8th issue.

**"R.W.C.J." (Newport)** *encloses a diagram of his five-valve receiver and asks* (1) *What would be the best tuner to use with the five-valve amplifier, honeycomb or single-layer coils.* (2) *If a variable condenser can be used with a set.* (3) *Will the set receive the Dutch concerts and Home concerts.* (4) *The capacities of the condensers* 1, 2, 3, 4, *and* 5.

(1) It depends on the wavelength required. Use solenoids for ranges up to 3,000 metres, and honeycombs if a wider range is required. Many examples of windings suitable for wavelengths of different ranges have been given recently. (2) Yes, in the closed circuit. Capacity 0·0005 mfd. for short waves, and 0·001 mfd. for long. (3) Yes. (4) Condensers 1, 2 and 3, 0·001 mfd.; No. 4, 0·0002 mfds.; and No. 5, 0·002 mfds. (N.B.—We should advise you to work with a simple set until you have obtained more experience.)

**"OHM SWEET OHM" (Lytham)** *asks* (1) *Which is the best circuit to use for a four-valve H.F. set.* (2) *Would this set receive* **PCGG, 2MT** *and the broadcasting stations.* (3) *If this set is powerful enough to work a Brown loud speaker.* (4) *Wavelength of the set.*

(1) See Fig. 4, page 437, July 1st, introducing a vernier condenser in parallel with a closed circuit condenser. (2) Yes, with a good aerial. (3) Yes, from fairly near stations, but we should prefer one or two stages of note magnification in place of the final H.F. magnification. (4) The closed circuit would tune to 4,500 metres. The primary will tune to this with a parallel condenser of 0·002 mfds., but it will be better to use a loading coil.

**"CHITTY-BANG-BANG," H.B. (Nottingham)** *wishes to construct a short wave receiver described in the issue of June 3rd, and asks* (1) *What is the capacity of the two variable condensers.* (2) *If a grid leak is necessary.* (3) *If the grid leak should be connected across the grid filament or shunted across the grid variable condenser.* (4) *If a L.F. transformer coupled amplifier can be connected in place of the telephones.*

(1) It is not necessary for these condensers to be variable, although the grid condenser might be, say, 0·0003 mfds. at maximum. The telephone condenser is about 0·001 mfds. (2) Yes, it should certainly be used. (3) Immaterial. (4) Yes.

## SHARE MARKET REPORT

Prices as we go to press on July 17th, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 7 | 0 |
| ,, Preference .. .. | 1 | 18 | 9 |
| ,, Inter. Marine .. .. | 1 | 8 | 9 |
| ,, Canadian .. .. | | 11 | 0 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 1 | 3 |
| Preference .. .. .. | | 15 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
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# A Tuner for all Wavelengths

By W. FORBES BOYD.

IT has been said that an efficient tuner is as good as an extra valve, and although this naturally assumes that comparison is made with a badly designed tuner, there is undoubtedly a certain amount of truth in the statement.

Wireless literature for amateurs is redundant with improved methods of amplification, but tuner design is only infrequently given, and these thoughts have prompted the writer to give the following particulars of a tuner in which he has attempted to combine efficiency at all wavelengths with facilities for quickly changing the wavelengths. This means that the aerial tuning inductance must be built up in sections which can, as far as possible, be isolated from one another not only electrically, but also magnetically, to prevent the "dead-end" effect that so often worries the amateur at short wavelengths.

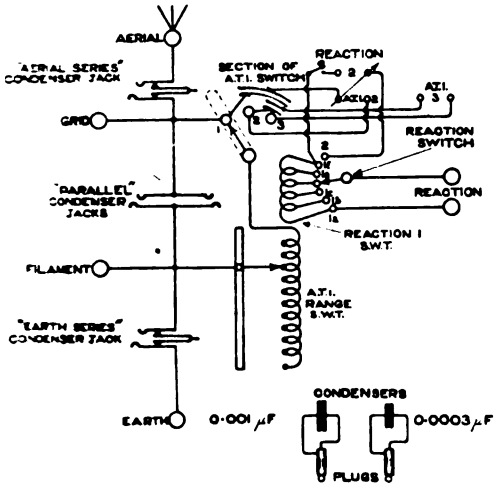
The writer has assumed that for efficiency, compactness and cheapness, the coils taken from the Mark III Short Wave Tuner are the most suitable for short wavelengths, and that the machine-wound duo-lateral type of loading coil, on account of its low equivalent or self capacity, combined with the space occupied, is the most efficient for the longer wavelengths, and for these reasons they are embodied in the design.

Two variable condensers of 0·001 and 0·0003 mfd. capacities are included in the tuner attached to concentric telephone plugs so that they may be connected :—

(*a*) In series with the aerial lead.
(*b*) In series with the earth lead.
(*c*) In parallel with the inductance.

These alternative positions for connecting up the condensers form an attractive feature of the design.

For short wavelengths the 0·001 mfd.



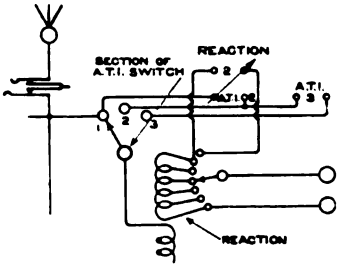




*Fig.* 1.

*Left figure shows diagram of connections and the right figure an alternative and simpler arrangement, but in order to "dead-end" the sections not in use, it is necessary to remove the idle coils.*

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condenser is connected in series with the aerial lead, and the 0·0003 mfd. condenser in series with the earth lead.

This arrangement, more especially the small earth series condenser, facilitates reaction at short wavelengths, and whereas reaction with parallel condensers fails at about 300 metres, it is safe to say that with series condensers reaction can easily be obtained at 100 metres or even a smaller wavelength.

The series aerial and earth jacks must be so arranged that when the condenser plug is

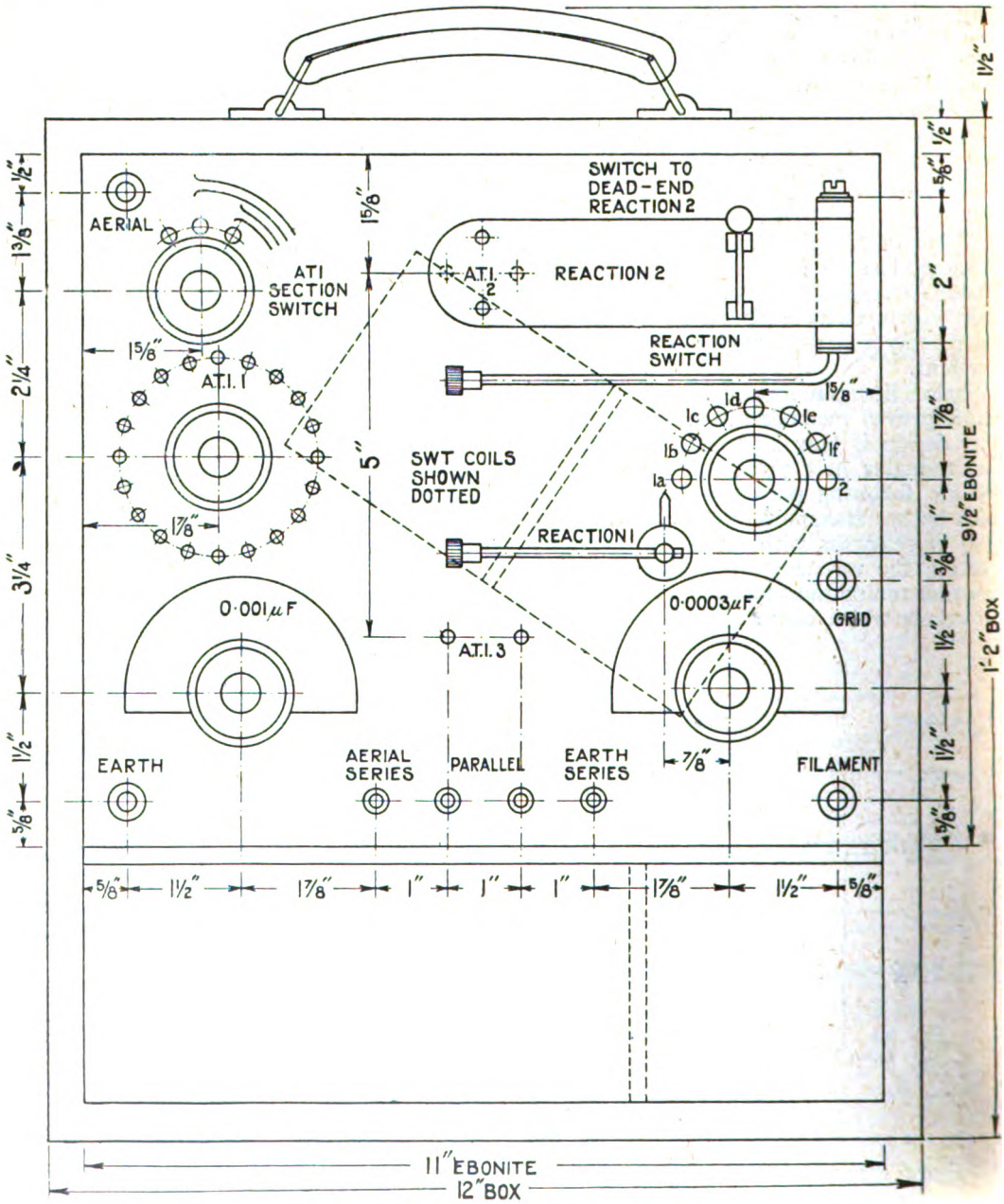


*Fig. 2. Showing the principal dimensions.*

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withdrawn the two contact pieces are shorted through the two centre contacts. This is done by using 4 or 5-way contact jacks and permanently connecting the two centre contacts together as shown in Fig. 1.

Another advantage of using the " plug-in " method of connecting condensers to the open oscillatory circuit is the fact that there is no gap in the range of wavelengths, which is sometimes the result when only one condenser is used with the ordinary series parallel switch. For example, using a particular inductance, one condenser and series parallel switch, wavelength may be obtained as follows :—

Condenser in series with inductance. Range (say) 300-600 m.

Condenser in parallel with inductance. Range 750-1,500 m.

And from the above it is seen that there is a gap in the wavelength between the series and parallel connections.

When using two condensers and the " plug-in " method of connection this gap can easily be bridged as follows :—

0·001 mfd. and 0·0003 condensers in series. Range (say) 300-600 m.

0·001 mfd. in series and 0·0003 in parallel. Range 500-1,000 m.

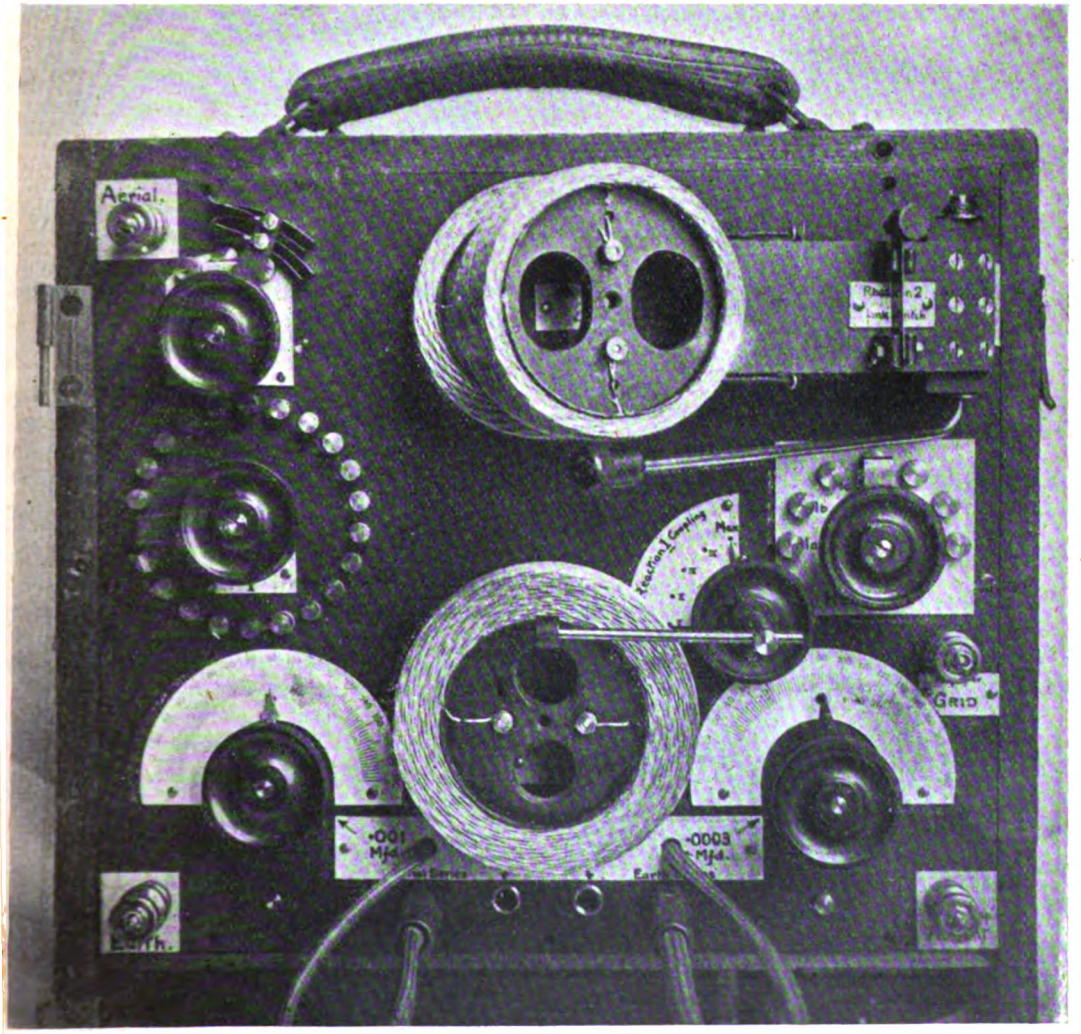


*Fig.* 3. *General Arrangement.*

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0·001 mfd. and 0·0003 condensers in parallel. Range 750-1,500 m.

So much for the condensers. The aerial tuning inductance at first sight is perhaps a little more involved, but in actual practice it is easily manipulated, and the design is such that all unnecessary complications have been omitted.

Actually there are two circuits in the tuner, which are used as aerial tuning inductance and reaction. The reaction circuit can easily be adapted so that it can be used as a closed or tuned oscillatory circuit, but in this article it is described as a standard reaction circuit.

The aerial tuning inductance is arranged in three sections, each section being isolated by means of the section or A.T.I. switch as shown in Fig. 1.

The first section of the inductance is the well-known single layer inductance taken from a Mark III short wave tuner, and is connected to a 19 point switch as shown in Fig. 1, marked A.T.I. Range 1.

The reaction for this section is the closed circuit, or loose coupled inductance taken from the Mark III short wave tuner, and has five tapping points.

These two coils are mounted under the ebonite face plate as shown dotted in Fig. 2.

The second and third sections of the inductance are duo-lateral coils, which are plugged into sockets on the outside face of the ebonite base-board.

The reaction for the second section of the inductance is also plugged into a movable arm by means of which the coupling can be altered.

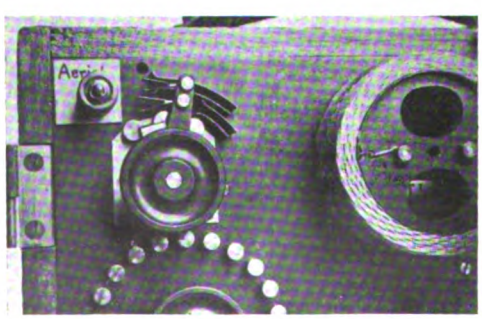


*Fig.* 4.

*The A.T.I. Section Switch, showing the "dead-ending" arrangement. The switch is moving from Range* 1 *to Range* 2, *and the wiper contact is on the point of bridging the two outer contact plates.*

In connecting up Range 1 of the inductance to Ranges 2 and 3, we could add 2 studs to the 10 point tapping switch and connect section 2 between studs 19 and 20 and section 3 between studs 20 and 21, but this arrangement, by adding the loading coils at the *end* of Range 1, would prevent the use of the 19 tapping points of Range 1 for fine tuning,

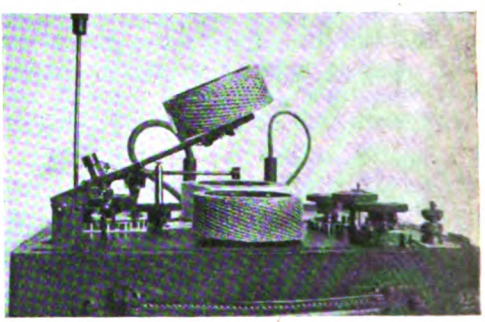

*Fig.* 5.

*View taken from top of tuner and showing the A.T.I. and Reaction Coils.*

and so Ranges 2 and 3 are connected by means of the section switch to the *beginning* of Range 1. This is a distinct advantage, especially when receiving telephony, when it is possible, by reducing the condenser valve to a minimum, and the inductance valve to a maximum, to increase the potential difference between the two ends of the inductance, and thus considerably improve the signal strength.

Coming now to the general lay-out of the various parts, it will be noticed that the ebonite face plate to which they are attached is designed to fit into the instrument section of a short wave tuner box. The smaller section, *i.e.*, the old telephone and battery compartments, are used to store the duo-lateral coils.

Fig. 2 is a sketch showing the principal dimensions and Fig. 3 is a photograph of the tuner. Ranges 1 of the A.T.I. and reaction are mounted on the underside of the ebonite, and as these coils are so well known, no details of them are necessary.

The following details of the other parts are given, as they depart to a certain extent from standard practice :—

A.T.I OR SECTION SWITCH.

This switch is shown in the top left-hand corner of the instrument, and not only adds sections 2 and 3 to the aerial tuning inductance,

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but isolates the section not in use. For example, when the contact arm is on stud No. 1, ranges 2 and 3 are absolutely disconnected in order to eliminate dead-end effect. This is done by vertical and curved contact plates which are short-circuited by two wiper arms attached to, but insulated from the contact arm. The contact plates are held firmly in place by driving them into saw-cuts in the ebonite.

Fig. 4 shows a nearer view of the section switch, the contact plates and the two wiper arms.

It will be noted that the outer contact plates are short-circuited when the contact arm is on studs 2 and 3, and that the inner contact plates are shorted only at stud 3. Reference to the diagram (Fig. 1) shows how these studs and contact plates are connected.

### Reaction for Ranges 2 and 3.

This is shown in Fig. 3 and also a view taken from the top of the tuner is shown in Fig. 5.

The reaction coil is plugged into the end of a thin fibre arm which is strengthened at the bearing end. The bearings are phosphor bronze or brass strips, which project through the ebonite face plate a sufficient distance to allow the arm to be horizontal with the ebonite face plate when in the maximum coupling position.

This means that there is a space under the fibre arm, and this space is used for the reaction terminals which are hidden from view, being behind the bearing strips.

The reaction terminals consist of two sockets into which a 2-pin plug fits, the plug being connected to the reaction leads from the amplifier. This allows the reaction coils to be quickly reversed, an advantage which users of H.F. magnification will appreciate.

### Duo-lateral Coils.

These coils are a well-known make, but the writer, not being satisfied with the standard method of mounting with plug and socket attached to the outside of the wire, has brought out an alternative design which has the advantage that the wire need not be handled when in use.

The method of coil mounting is shown in the photographs, and it will be noticed that two large holes are cut in the ebonite centre-piece to facilitate handling. The inside of the coil is first lined with fibre paper, the centre-piece is pressed into position, and with the use of "Seccotine" or shellac is held firmly in position.

The ebonite centre-piece is $\frac{3}{8}$ in. thick, and the top of the ebonite is $\frac{1}{8}$ in. lower than the top of the coil, so that the nuts which hold the split pins are practically flush with the top of the coil.

### Application.

In using the tuner it will be found that reaction can be readily obtained on the shortest wavelengths if the condensers are connected in the aerial series and earth series positions, especially if the value of the earth series condenser be kept small.

When using the condensers in the parallel position always use the smallest value of condenser and the largest value of inductance. For example, 1,000 metre telephony can be received on Range 1 with the 0·001 mfd. condenser in the parallel position, but it can also be obtained by adding a 150 turn duo-lateral coil at Range 2, and connecting the 0·001 mfd. condenser in the aerial series position. This latter combination gives practically double the signal strength.

Then again it often happens that one wants to listen-in to 180 m. and 1,000 m. telephony, and at more or less the same time to keep in touch with stations which are transmitting at from 2,000 to, say, 5,000 metres.

For the purpose of tuning to short wavelengths such as the telephony which is transmitted on 280 to 450 metres, it may be found convenient to substitute ebonite control levers for the brass ones shown in the photograph (Fig. 3). Extension rods might also be fitted for critically revolving the condensers and making manipulation possible without bringing the hands too near to the coils and other parts of the receiver.

The A.T.I. section switch allows this to be done at maximum efficiency without changing any of the inductances.

In conclusion, it is not claimed that the above article involves any new principles or describes the simplest form of tuner, but at a time when everyone is working for better results it must be understood that a certain amount of complication is necessary, and when once mastered it will be found to be well worth the trouble, so that possibly the last valve in the amplifier will be scrapped after all.

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# Wireless Exhibition & Convention

## September 30th—October 7th, 1922.

ARRANGEMENTS have been made for a Wireless Exhibition and Convention to be held at the Horticultural Hall, Westminster, from Saturday, September 30th, to Saturday, October 7th inclusive.

Hitherto the interest of the general public in wireless has not been sufficient to justify the holding of an all-wireless exhibition in London on any large scale. With the advent of Broadcasting, and the great increase in interest taken in wireless, and wireless telephony in particular, there is ample scope for a really comprehensive exhibition, which may be expected to draw huge crowds.

The present Exhibition and Convention is being held under the auspices of the Wireless Society of London, and with the support of the affiliated Societies. It is obvious that no exhibition of this nature could hope to be a complete success without the co-operation of the wireless societies, or at least their goodwill. It is therefore hoped that Secretaries of Societies will bring the Exhibition to the notice of their members, in order that the Societies may be represented by as large an attendance as possible.

The social side of the exhibition will be conducted by the officers of the Wireless Society of London, and the co-operation of the affiliated Societies is required in these arrangements.

The Managers of the Exhibition, Messrs. Bertram Day & Company of 9 & 10, Charing Cross, S.W.1, are arranging that special accommodation shall be given for demonstrations and lectures, to be open to all visitors to the Exhibition, and it is expected that it will be possible to organise something of this nature to be in progress at all times throughout the period of the Exhibition.

At the present time, when so much public attention is being paid to the question of the support of British industries, it is not surprising to learn that the Postmaster-General is proposing to give to British firms the monopoly of supplying apparatus for the Broadcasting for a period of two years. Such a start should enable the industry, which is largely a new field for manufacturers in this country, to lay for itself a foundation which will be able to withstand the force of later competition from abroad. In this connection it is most gratifying to learn that the managers of the present Exhibition have decided that this shall be an all-British event, and that only British manufacturers of wireless apparatus shall be invited to exhibit.

This is a point which the Committee of the Wireless Society of London had not been slow to appreciate, and no doubt the affiliated societies are all agreed as to the importance of supporting British industries in the wireless boom. Each individual can do his share in this direction by insisting that whatever apparatus he may purchase from time to time should bear the hall mark of British manufacture.

Taking into consideration the difficulty which many of those interested in wireless would find in attending the Exhibition during ordinary weekdays, it is interesting to note that the period during which the Exhibition will be open embraces two Saturdays, and this arrangement should appeal to those in the provinces who may only be able to come up to London at the week ends.

The price of tickets for the Exhibition will be 1s. 3d. (including tax). A Trade Day will be held on Monday, October 2nd. Tuesday, October 3rd, will be a Special Day for the public, when 5s. will be charged. On both these special days there will be admission at ordinary prices after 6 p.m.

The Managers of the Exhibition are arranging to supply to the Wireless Society of London a number of complimentary tickets for distribution amongst their members and affiliated Societies.

An orchestra is to be provided, and arrangements will be made with a good firm of caterers for refreshments to be available for the public.

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# Time Signals

## THE TRANSMISSIONS FROM EIFFEL TOWER

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

THE most important routine work of an astronomical observatory is the determination of exact time. This is done every evening when weather and sky conditions permit, but it frequently occurs, and especially in winter, that it is not possible to make astronomical observations of the transits of stars every night. It is therefore necessary to be satisfied with the times registered by the chronometers kept at the observatory. When the "rates" of the separate chronometers are known and the chronometers themselves are sufficiently numerous and accurate, such a procedure causes no inconvenience so long as the cessation of transit observations does not exceed a few days at the most. If, on the other hand, the period of cloudy weather continues too long, it is no longer possible to answer for the accuracy of the chronometers. Wireless telegraphy in such cases furnishes a method which allows of the co-operation of other observatories more fortunately situated as regards climatic conditions in the determination of the state of the master control clock.

The time signals sent out by Eiffel Tower are controlled by apparatus situated at the Paris Observatory and under the direct supervision of the staff of that institution. For this purpose the Observatory is connected up by underground wires with the transmitting apparatus at FL (Figs. 1 and 2). The pendula which control the emission of the 300 rythmic beats or scientific signals are kept at the Eiffel Tower station and these are shown on the left of the terminus panel in Fig. 1.

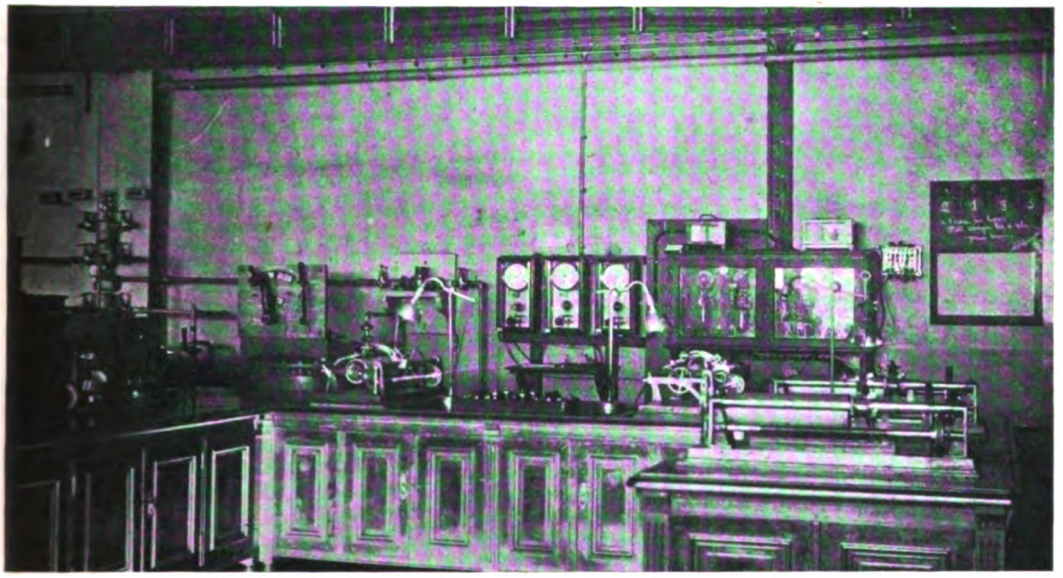

*Fig. 1. Interior of Eiffel Tower. The glass case against the wall is the terminus of the underground lines connecting the Paris Observatory with the transmission apparatus at* FL. *The pendula employed for transmitting the rythmic signals are shown on the left of the case.*

### ORDINARY TIME SIGNALS (FRENCH SYSTEM).

The ordinary time signals shown in Fig. 3, transmitted twice daily, at 1044 and 2244, are semi-automatic. The dots at 45, 47 and 49 minutes past the hour are the only signals sent automatically, all the other signals being sent by hand by an operator at the Observatory. A few minutes before the transmission takes place, connection



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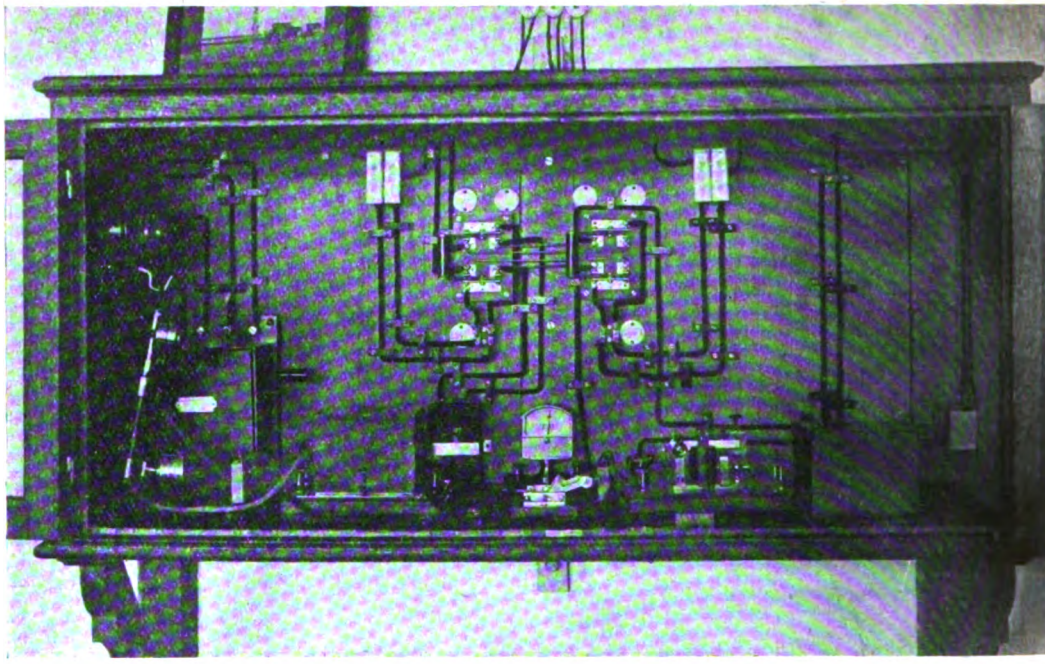

*Fig. 2. Details of terminus shown in Fig. 1.*

is established with the transmitting apparatus at FL through the underground lines referred to above. The automatic signals at 45, 47 and 49 minutes past the hour are given by a clock placed in the time-keeping room at the Paris Observatory. This clock operates the three cams *A*, *B* and *C* (Fig. 4). *A* makes one complete turn in 24 hours and has two notches, one corresponding to 10h. 44m. 30s., and the other to 22h. 44m. 30s.. The function of this cam is to permit of the closing of the contacts at the correct hour. The length of the notches corresponds to a duration of five minutes. *B* makes one complete turn in one hour and has three notches, corresponding respectively to 44m. 30s., 46m. 30s. and

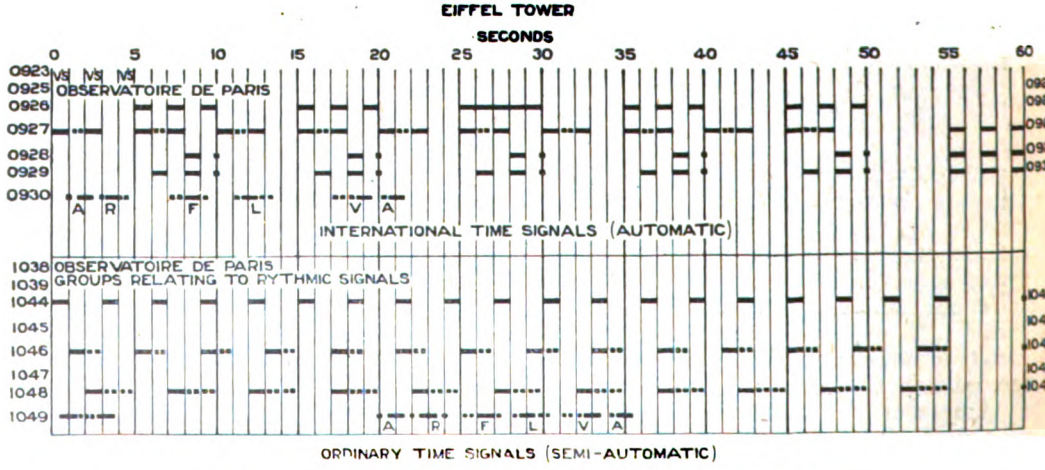
EIFFEL TOWER
SECONDS
0 5 10 15 20 25 30 35 40 45 50 55 60
OBSERVATOIRE DE PARIS
A R F L V A
INTERNATIONAL TIME SIGNALS (AUTOMATIC)
OBSERVATOIRE DE PARIS
GROUPS RELATING TO RYTHMIC SIGNALS
A R F L V A
ORDINARY TIME SIGNALS (SEMI-AUTOMATIC)

*Fig. 3. Method of transmitting time signals from Eiffel Tower.*

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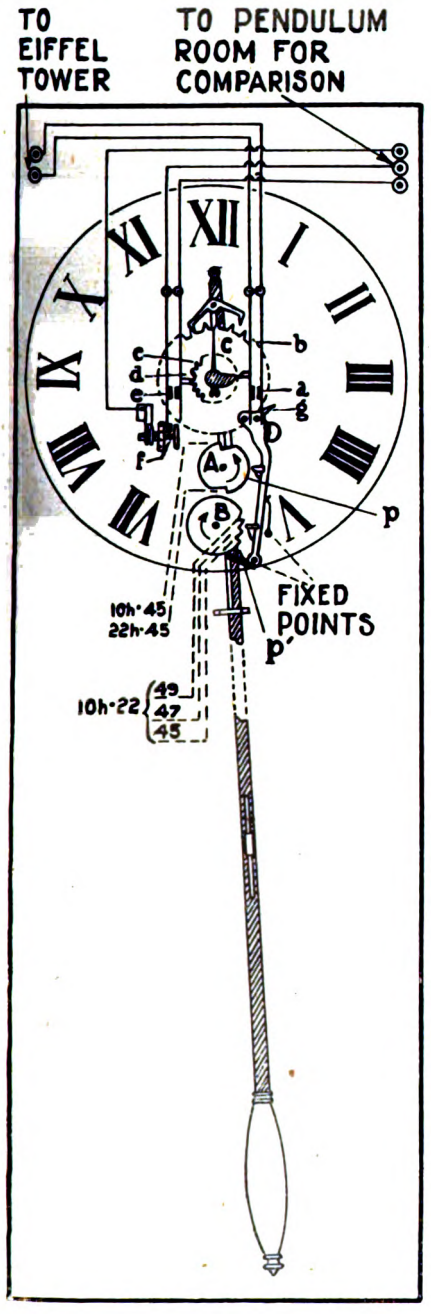


*Fig.* 4.

*Pendulum used for transmitting automatically the T.S. at* 1045–47–49 *and* 2245–47–49 *from the Paris Observatory.*
*a* = *sending contact.* *b* = *seconds pointer.*
*c* = *toothed seconds wheel.*
*d* = *zero second.* *e* = *contact for synchronising time signal and pendulum.*
*f* = *listening-in contact.* *g* = *insulated studs*

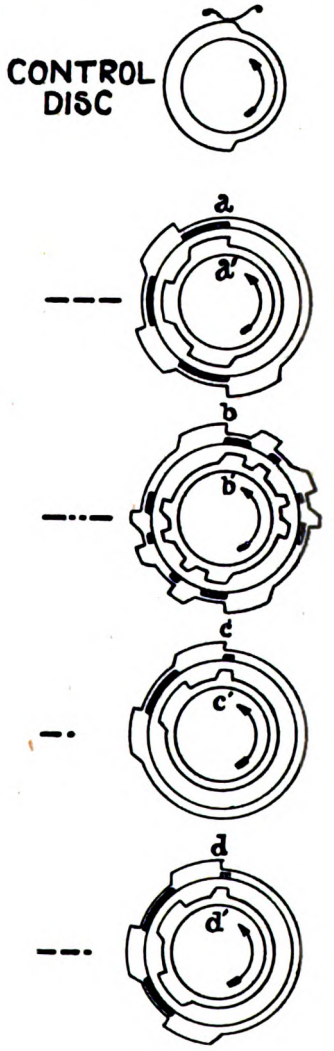


*Fig.* 5.

*Details of the Discs Mounted on* $O^2$ $O^2$ *(Fig.*7*). The discs have equal diameters; the outer circles represent the underneath discs, which function the closing of the circuits; the inner circles represent the upper discs which function the breaking of the circuits.*

48m. 30s. Similarly, this cam permits of the closing of the contacts at the correct minutes. Finally, *C* makes one complete turn every minute and controls the time signal.



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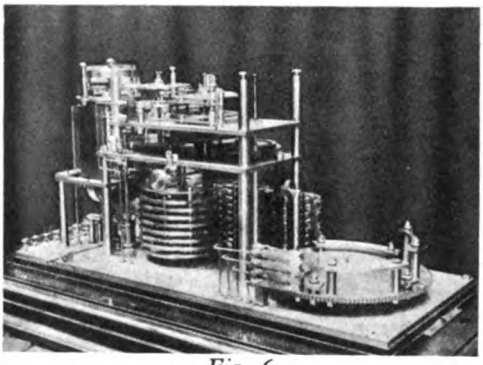

*Fig. 6.*

*The Brillié-Leroy apparatus which automatically transmits the International time signal from* FL *daily.*

When the gears $p$ and $p^1$, carrying with them the lever $D$, run into the notches of the cams $A$ and $B$, the lever $D$ is displaced towards the left and this sets free the springs of the transmission contact. This contact can then be closed by the cam $C$ at the zero second, *i.e.*, 45, 47 or 49 minutes exactly. But actually, in practice, $C$ does not function on the exact minute. The position of the cam $C$ with regard to the toothed seconds wheel is such that the transmission contact $a$ is closed 0·20 seconds before the "listening-in" contact $f$. This is to compensate for the self-induction and consequent lag in the instruments between the observatory and the aerial at FL.

AUTOMATIC DAILY TIME SIGNALS AT 0923.

The apparatus employed in automatically transmitting the International Signals is much more elaborate than that described above. Fig. 6 is a photograph of the Brillié-Leroy apparatus now employed for this purpose. Reference should now be made to the circuit-diagram in Fig. 7, in conjunction with the brief description which follows.

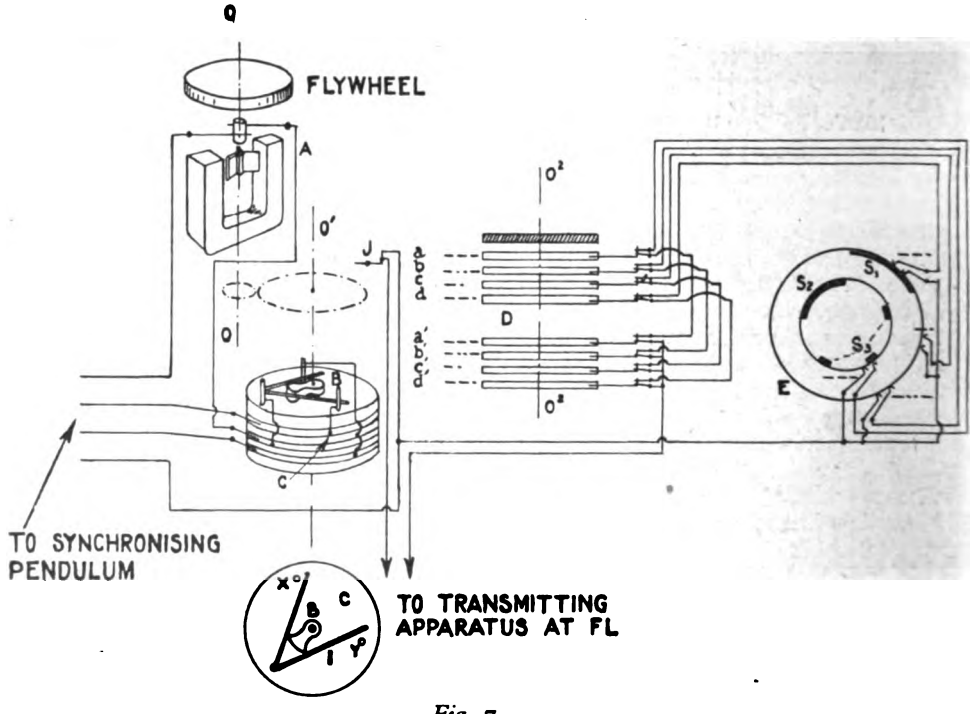


*Fig. 7.*

*Circuit diagram of the Billié-Leroy Automatic Time Signal Apparatus.*
*(A) Motor which drives the whole of the apparatus. (B) Cam secured to o'. (C) Insulated support carrying three rings. (D) Drum with cams setting in action the contact levers a, b, c, d, a', b', c', d'. O² O² axis of transmitting disc (one turn in ten seconds). (E) Wheel commutator closing the circuits. (I) Fork operated by the cam B, alternately closing circuits X and Y every half second. (J) Interrupter automatically closing the circuit at 9h. 26m.*

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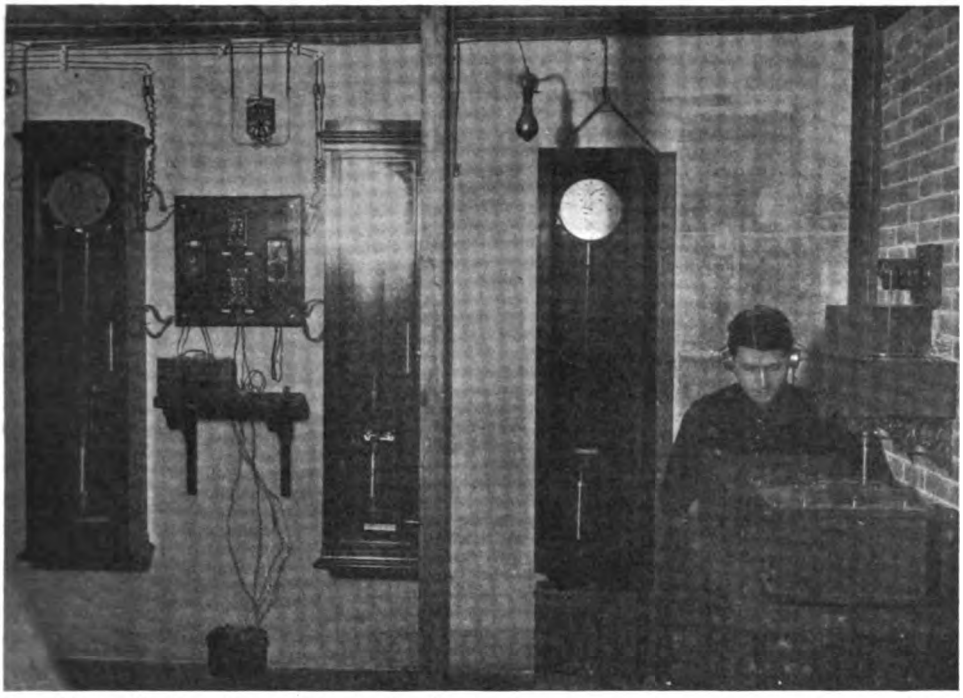

*Fig 8. After adjusting the pendula the lag due to the automatic transmission apparatus interposed between the pendulum and the aerial is measured before the time signal is sent out.*

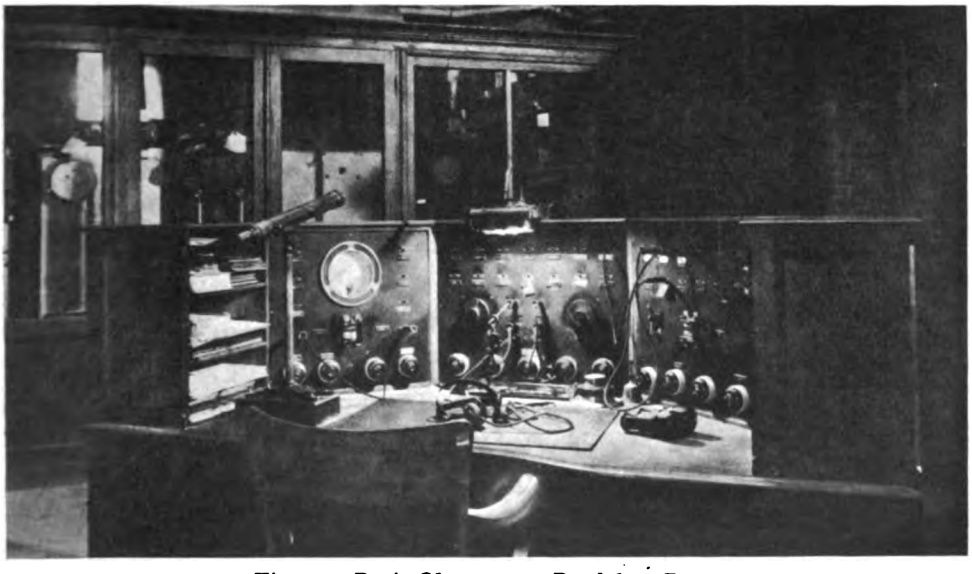

*Fig. 9. Paris Observatory Pendulum Room.*

*Central telephone desk used for the comparison of all the pendula at the observatory by the method of coincidences by ear and also by aural comparison of the pendulum controlling the scientific time signal sent out by Paris, Lyons and Bordeaux.*

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The pendulum of the master clock at the Observatory functions a small electrically-controlled pendulum. which in its turn synchronises the motor *A* of the signal transmission apparatus. The motor receives every second the emissions of current from the pendulum through the intermediary of a commutator. *O'* is the axis of the synchronising commutator, which completes one turn per second. The armature of the motor has three branches and turns between the two poles of an electro-magnet. It receives its current from a battery of four accumulators. The wheel commutator *E* is also functioned by the motor and makes one complete turn in five minutes. This wheel carries a sector $S_1$, whose length corresponds to 55 seconds approximately. This sector closes successively the three circuits —• • —, —•, ——•, each of 55 seconds duration, and forming the signals of the last three minutes. The sector $S_2$, whose length again corresponds to 55 seconds of time, closes the circuit — — —, forming the first minute of the signals. In the same way the sectors $S_3$, of length corresponding to five seconds of time, close the circuit — — —, which are the signals at the end of the last three minutes of the time signal.

Figures 8 and 9 illustrate other apparatus at the Paris Observatory.

The eight discs *a*, *b*, *c*, *d*, *a'*, *b'*, *c'*, *d'*, turn once every ten seconds and send out the signals shown against them. They are furnished with notches; one set establishes, the other cuts off the current which actions the relays of the sending apparatus. They are shown in detail in Fig. 7.

It is regretted that in the article on Time Signals which appeared in the issue of July 15th, an error has been made in the last paragraph. Instead of " Similarly, by altering the position of $A_2$, the two series (local pendulum and T.S.) may be superimposed," should be read " The operator then finds by trial a position for $A_2$ which enables him to hear a time signal between two beats, or inversely, a beat between two time signals."

[*We wish to acknowledge indebtedness to General Ferrié for the very kind assistance which he has given to the author in supplying information used in the preparation of the present article.*—ED.]

# The Capacity Unit.

By R. C. CLINKER, M.I.E.E.

IS it not high time that we dispensed with the decimal point, together with its row of noughts which are almost invariably used when designating the capacity of a radio-frequency condenser? If we want to tell a friend how much we put into a collection box we don't say " no pounds, no shillings and no-pence halfpenny." Why, then, should we write the capacity of a grid condenser as 0·0003, when " 300 m.m.f." is so much more quickly grasped, once one is used to the smaller unit?

It is rather unfortunate that the practical unit of capacity is so large. I remember that, when first learning my units, I asked how large a thing a farad was, and I got for answer: " about the size of a haystack." Further enquiry as to the reason for this enormous bulk elicited the information that it is " co-mensurate with the greatness of the genius whose name it bears." However this might be, the farad had very soon to be divided into a million parts to make it convenient for laboratory use, and now it is surely time that all wireless men agreed to again divide by a million, and to use the micromicrofarad (MMF or $\mu\mu$F) as a more convenient unit.

Personally, for quick calculation, I prefer the centimetre unit, although it is related in size to the MMF by an awkward ratio, viz., 1:0·9. The reason I find it convenient is as follows:—If we measure capacity (*C*) in cm., and inductance (*L*) in millihenries, it is easy to find the wavelength by remembering that a product (*LC*) of 1,000 gives almost exactly 2,000 metres (1,985, to be exact). If, then, we have a certain product, the corresponding wavelength is quickly found on a slide-rule by setting the 1 on the top slider-scale opposite the product, and reading off the wavelength on the bottom fixed scale at the point where the 2 on the bottom slider-scale is found. If one prefers the microhenry as an inductance unit, one can use the " jar " (1,000 cm.) as the capacity unit, and get the same convenient product. No doubt this procedure makes use of a mixture of units, but it is a handy mixture. In any case, it is surely advantageous to eliminate those serried rows of o's which worry the mind and eyesight, to say nothing of the exasperation to the compositor. What a stock of decimal points and zeros *The Wireless World and Radio Review* printing office must hold!

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# Experimental Transmissions between Aberdeen and London

## AN ACCOUNT OF TESTS CONDUCTED BY 2 UV AND 2 JZ.

By W. E. F. CORSHAM.

GREAT interest has recently been aroused in the tests carried out by Mr. Spence of Aberdeen and myself at Willesden, London, and it has been suggested that an account of some of the most important transmissions should be "written up," together with a detailed description of the apparatus used at the respective stations. Unfortunately, however, Mr. Spence, or as he is better known to the amateur, **2 JZ**, is working on a special circuit and is not quite ready to give a complete description of his apparatus yet, but that will doubtless be forthcoming at a later date. He experiments with practically every system of telephony transmission, and we have had wonderful results at times. One night four different circuits were tried in succession, and each proved successful in bridging the distance. Details of his receiving circuit will be found in *The Wireless World* of February 4th, 1922. At the present, therefore, I am devoting this article to the chief features of the Aberdeen Tests and a description of **2 UV**. Since the result of the transatlantic tests, experiments between London and Aberdeen have been practically continuous night after night, my own part in these experiments taking place on Saturday and Sunday nights after 9 p.m., when I have had excellent results, speech and music from **2 JZ** being clearly read on my three-valve set through heavy jamming from ships and static. Time after time I have been able to report "your speech and music O.K., old man," when other stations have reported "carrier wave O.K., but no speech," and each report to **2 JZ** carried conviction in the shape of either the words used or the name of the gramophone record transmitted. But soon local amateurs began to get wind of what was happening and the chorus of howls from oscillating receivers began to swell the QRM very considerably, making reception terribly hard, the faint voice being heterodyned by numerous howls of various intensities, but reception was still possible, and it was only when spark jamming became really bad that I failed in getting the whole of **2 JZ**'s speech. On one occasion the s.s. *Brighton* commenced work with Dieppe at the exact hour the test was arranged for. We had made it 11 p.m. that night so as to clear most amateur jamming, and **MOV** kept up a series of messages until well after the time the test finished, and the arrival of a healthy harmonic from **GBL** completed the only actual failure I have had. By far the most successful transmissions took place on the 9th and 10th of April, 1922. At 10 p.m. on the 9th, **2 JZ** called **2 UV** and said, "Will send to you for five minutes on 180 metres at 9 p.m. to-morrow; please stand by for me," and then followed music, which I received very well, and he then gave me "K." At 10.30 I commenced calling **2 JZ** on the tonic train transmitter, acknowledging receipt of his message and music, and gave him "K." **2 JZ** replied at once, informing me that he was receiving me, and stated "Sigs quite readable at first, but very faint later, not harsh but characteristic." During the tonic train transmission the break on the spark coil failed and I repeated the wait signal continually, all of which was faithfully reported by **2 JZ** in his letter to me, and it was a most remarkable transmission, as **2 UV** was only radiating 0·09 at the time. It seems to be a most strange thing, but the note of the spark coil seems to have a very great effect upon the distance the tonic train will cover. I have had various adjustments from a low harsh note to a high-pitched whistle, and although in every case the ammeter readings were the same, yet there is one tone which seems twice as strong and seems to eat up distance. This is apparently what happened in the above case. When I altered the make and break I altered the tone as well, and signal strength fell off, hence **2 JZ**'s report that signals were O.K. at first, but got fainter after my alterations. On the evening of the 10th, **2 JZ** called me on 180 metres, radiating 0·45 from a single wire aerial 40 ft. long and 30 ft. high, directed due east and close up against a house at the south. This transmission was badly jammed by a **GFA** harmonic, but again **2 UV** reported "your signals O.K. on 180 metres," another excellent night's work, the 500 miles between **2 JZ** and **2 UV** being covered on extraordinarily low power. Good speech has been received from **2 JZ** when his input has been less than 50 watts. These are the most important tests carried out by **2 JZ** and myself, a very noticeable point being that during the best reception of **2 JZ** here I have noticed that the local weather has been cloudy and in some cases wet. It will be remembered that in the Transatlantic test the best nights of reception were when the weather over the Atlantic was very rough, so that apparently bad weather helps wireless transmissions very considerably. A very curious point was noticed during a transmission from **2 LG** of Birmingham to me a few weeks back. **2 LG**'s note was reported at Birmingham as being a very clear and intense C.W., but was received here in Willesden a scratchy hiss, sounding, in fact, like an arc harmonic with plenty of "hash," a very interesting note. The receiving side of **2 UV** consists of a three-valve low frequency detector amplifier; its connections will be found in the complete station wiring diagram, and will be seen to differ slightly from the usual. Its finest test was its reception of the American amateurs during the Transatlantic test, and it has proved a very efficient all-round receiver for distance work. Distortion in speech is not noticeable to the human ear on the fainter signals, and can be cleared on the louder signals by taking the circuit a little further off oscillation. Actually, the distortion noticed is ridiculously slight and not worth troubling about on a station that has to be prepared to pick up 'phone and Morse work at short notice. In my opinion the distortion complaints that the poor low frequency circuit has to put up with have been considerably overdone. I have used a low frequency circuit for nearly four years now, and in practice I find that distortion is very very

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slight. The Dutch Concert has always been readable to me by its means, even on her very low power, and it would pay some experimenters to do a little more experimenting in low frequency work. 600 metre work is very good, the Italian shore stations being readable when they can be picked out of the QRM, and no difficulty is experienced in reading the American high power stations at any period of the 48 hours. The transmitter is slightly different to the usual, and is divided into two parts—tonic train and continuous wave. In the accompanying Fig. 1 it can be seen on the extreme left, and as can be seen from the diagram (Fig. 2), is very easily changed to either side. The feed for tonic train consists of a small ¼-inch spark coil, fed from a 4-volt battery, and the C.W. side consists of a high-tension battery of 150 volts made up from 4-volt flash lamp batteries. A

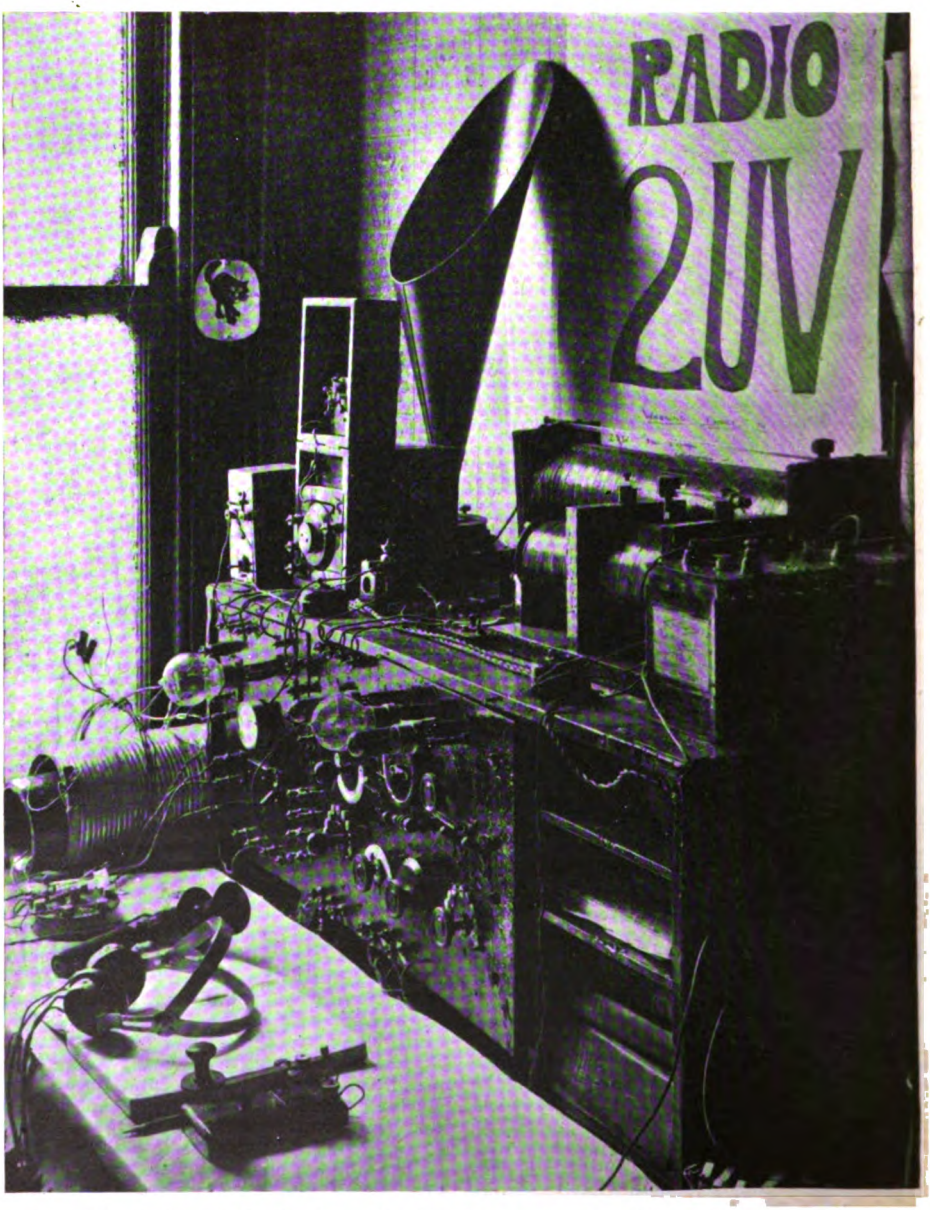


*Fig.* 1. *The Station of Mr. Corsham, showing the apparatus used in conducting the experiments described in this article.*

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generator is on the station, but cannot be used until the Council lay the mains near to the house. Telephony is obtained by means of a coil coupled to the aerial circuit, a heavily damped microphone being essential for speech and a fairly sensitive one for music. The music is transmitted by means

have both received C.W. signals from me when I was only using 8 volts on the plate of the transmission valve, 2 SX using two valves for reception, and 2 VW only one. In all cases signals were quite readable. The power valve is an AT.40, and the present valves for receiving are Mullard

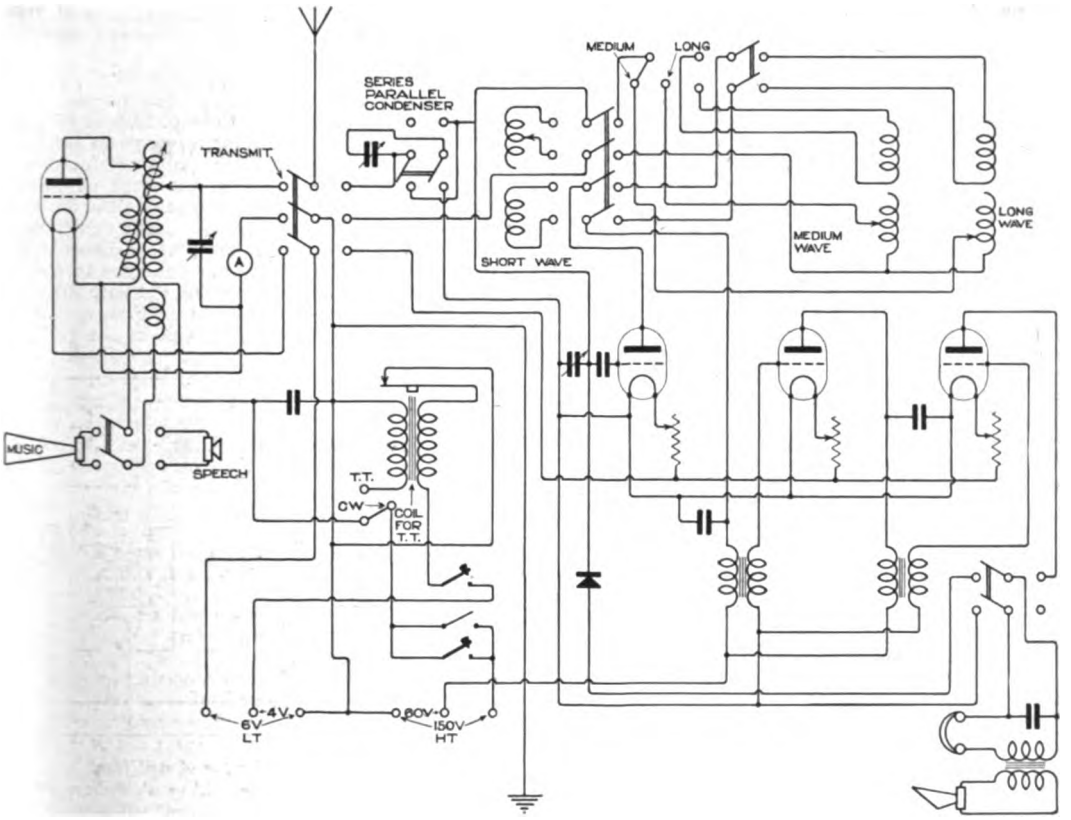


*Fig. 2. Circuit diagram of* 2 UV.

of a large horn fixed over the opening of the gramophone, and when properly adjusted is quite satisfactory. Some very satisfactory low power tests have recently been carried out from this station, speech and music being successfully received by 2 OD, Gerrard's Cross, receiving on four valves, the input to the power valve being only 14 volts, and 2 SX of Putney and 2 VW of Chalk Farm

"Ora"; previous to this, French "R" type valves were in use. I hope in further tests to increase my tonic train transmitting range very considerably, and always welcome reports from amateurs receiving my signals. The whole of 2 UV is home constructed, and most of the parts are home made.

**Will those who have not yet forwarded particulars of their Transmitting Stations kindly do so.**

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# An Amplifier for the Broadcasting

By G. P. KENDALL, B.Sc.

THE instrument herein described is intended to meet the needs of those who wish to construct from standard components a simple but effective amplifier for picking up the programmes of the broadcasting stations. On a fair aerial it may be expected to give signals strong enough for a loud-speaker from several of the stations, except, of course, in very out-of-the-way localities.

Three valves are employed, one as H.F. amplifier, one as rectifier, and one to magnify at audio frequency. The circuit is shown in Fig. 1. As will be seen, a two-stud switch is included to enable either of two H.F. intervalve couplings to be used, the first being a semi-aperiodic reactance-capacity type, and the second the well-known "tuned anode" coupling, which is probably the most efficient known. It is intended that the untuned coupling shall be used when searching for a station, and when the signals have been picked up and the aerial circuit tuned to them the switch is to be placed on No. 2 stud and the plate circuit tuned to the wavelength of the aerial. (This generally involves a slight readjustment of aerial tuning, and also of reaction coupling.) The signals will then be heard more loudly and with less interference from other stations.

CONSTRUCTION.

The first requirement is an ebonite panel 12 × 14 × ¼ ins., which is best obtained cut to size and rubbed down matt. All the parts are to be mounted on this panel, which may desirably form the lid of a shallow box.

Fig. 2 indicates the general arrangement of the parts, but does not give exact dimensions, since these must depend to some extent upon the make of the various components. A list of components and materials required follows:—

Three valve sockets; three filament resistances; one grid leak of 2 megohms; one grid condenser of 0·0003 mfd.; one blocking condenser of 0·003 mfd. ($C_2$ in Fig. 1); ditto of 0·001 mfd. ($C_3$ in Fig. 1); one reservoir condenser ($C_4$) preferably a 0·3 mfd. Mansbridge. Any large fixed condenser will serve, provided the capacity is not less than 0·005 mfd.; one L.F. intervalve transformer; one 0·0002 mfd. variable condenser for panel mounting ($C_1$); ivorine scale for the above; two switch arms; one dozen switch studs; piece of ¼ in. ebonite 3 ins. square; 5 ins. of 3 in. diameter ebonite tube; ½ oz. of No. 40 d.s.c. resistance wire; 4 ozs. of No. 22 d.c.c. copper wire; 10 terminals.

The semi-aperiodic reactance coil is to be wound on a bobbin made by turning from the piece of ¼ in. ebonite a disc 2¼ ins. in diameter, and then cutting a groove 1/16 in. wide and ⅛ in. deep in its edge. (If you have no lathe any machinist will do it for you.) In the groove wind 70 turns of the resistance wire, bringing the ends either to two small terminals mounted on the ebonite disc, or else soldering them to two thicker wires which can be secured by passing them through holes in the bobbin as shown in Fig. 3. The completed coil is to be screwed to the under side of the panel in the position indicated in Fig. 2.

The plate circuit tuning coil ($L_2$ in Fig. 1) consists of 4 ins. of single layer winding on the 5 in. by 3 in. ebonite tube. Use the No. 22 wire for this coil, and make nine points for tappings to the ten-stud switch. Directions for winding follow:—First drill two ⅛ in. holes in the tube at points ¼ in. from each end; these are to enable the finished coil to be fastened to the panel. Next drill a pair of 1/16 in. holes at each end, at a distance of ½ in. from the ends; these four holes are to secure the ends of the winding by passing the wire through them in the manner illustrated in Fig. 4, and they are best placed at the opposite side of the tube to

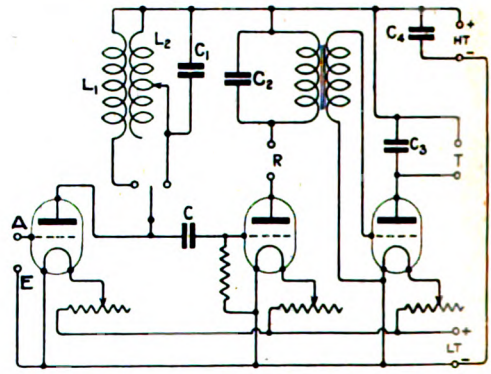


*Fig. 1. Circuit for the Amplifier.*
*R = Reaction Terminals. T = Telephones.*

the securing holes, in order that the ends of the wire may be in a convenient position when the coil is fastened in place. Having secured the end, proceed to wind on the wire in a single close layer winding by revolving the tube, and *not* by passing the wire round and round it. When about an inch of the former has been filled make a loop for the first tapping, then continue winding and making loops at intervals of ⅛ in. until the ten sections have been wound on, the end of the last section being secured by passing the wire through the two 1/16 in. holes. The tapping points are made by twisting up a loop in the wire of about ⅛ in. diameter at the required places; do not put in more twist than is necessary to maintain the loop, which will probably be one turn or thereabouts. It is, perhaps, a rather over-careful attention to details which prompts this warning, since the increase in the self-capacity of the coil which would be produced by a number of tightly twisted loops is probably very minute. However, the writer holds strongly that it is by attending to such little things throughout a receiver that the additional 5 per cent. of efficiency is obtained which makes your set better

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than the other fellow's. This example shows the principle carried rather to excess, but serves to emphasise a point upon which most old hands agree. A better but more troublesome method of making loops which will appeal to those who think, like the writer, that no trouble is too great in the cause of efficiency, is shown in Fig. 5. As will be seen, the loop is secured by a small ebonite or fibre washer, which is quite a satisfactory method for the thicker

a moderately warm oven, then soak in the wax for ten minutes, or until bubbles cease to rise from it, lift it out and drain as much of the wax off as possible. Since the size of the coil is such as to necessitate the use of a rather large wax-bath it may be easier to use varnish. If it is decided to do so, obtain the varnish from an electrical supply stores, and *not* from an ordinary paint and colour merchant. If desired, it can be made by dissolving

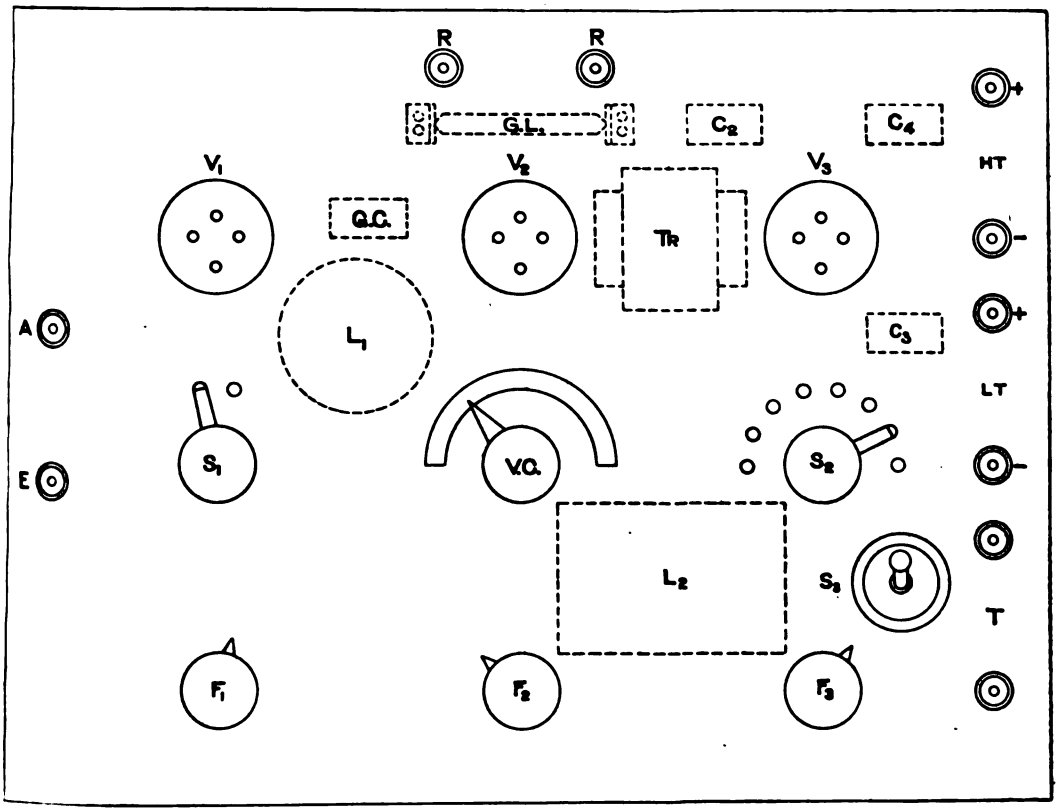


*Fig. 2. The lay out of the panel (not to scale).*

$V_1$, $V_2$, $V_3$ = Valve Sockets. $F_1$, $F_2$, $F_3$ = Filament Resistances. VC = Variable Condenser. $S_1$ = Two-way Switch. $S_2$ = Ten-way Switch. $S_3$ = Small Tumbler Switch for Filament Current Dotted lines indicate the position of components on the underside of the panel. G.L. = Grid Leak between Clips. G.C. = Grid Condenser. Tr. = L.F. Transformer. The other lettering corresponds to that of Fig. 1.

gauges of wire. If difficulty is experienced in obtaining the washers they may be easily cut from 1/32 or 1/16 in. sheet by means of a tool made by filing up a sharp edge to the end of a piece of ¼ in. brass tube. If this tool is heated it will be found quite easy to press it through the ebonite. (Drill the centre hole of the washer first, of course.)

When the winding is completed the coil must be damp-proofed, and this can be done with either paraffin wax or shellac varnish, according to preference. If wax is used it should be melted in some form of double boiler, such as a jam jar standing in a saucepan of boiling water. Dry the coil thoroughly in front of a fire, or (preferably) in an ounce of brown shellac in about half a cupful of methylated spirit. The lac takes some time to dissolve, so it should be put in a wide-necked bottle with the spirit and left for two or three days, with occasional shaking. Apply a thin coat to the coil, using sufficient varnish to thoroughly impregnate the cotton covering of the wire, but no more. It saves trouble later if one avoids varnishing the tapping loops, since these will later have to be scraped bare and soldered upon.

After varnishing, the coil must be thoroughly dried by baking in a moderately hot oven. (If it is a gas oven turn off the gas jets before you put in the coil, or you may have an explosion from the

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alcohol vapour.) After cooling, the coil is to be fastened to the under side of the panel in the position indicated in Fig. 2, by means of two ⅛ in. by 1 in. brass screws and nuts, passing through the two ⅛ in. holes in the tube. It is better not to screw the coil up tightly against the panel but to arrange for it to be held about half-an-inch below it. This is easily done by the use of an ebonite bushing on each screw, which can be made by cutting a ½ in. length of ¼ in. diameter ebonite tube for each.

Fig. 6 shows one end of the tube in section and should make the use of the bushing quite clear. The commencing end of the winding (*i.e.*, that with the 1 in. section) is to be connected to the H.T. positive terminal, while the tapping points and the other end of the coil are to be connected up in order to the studs of the ten point switch. The moving arm of this switch is then to be connected to No. 2 stud of the two-way switch.

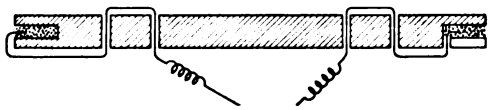

*Fig.* 3.

The completion of the amplifier is now only a matter of drilling the necessary holes in the panel and attaching the ready-made components in the positions indicated, and then connecting them up. This part of the work should not require any more detailed guidance than that given by the following hints on the wiring: use No. 16 or 18 wire, preferably bare tinned copper, and try to keep all connections as straight and direct as possible. At

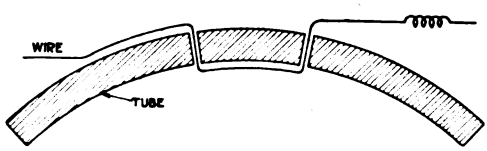


*Fig.* 4. *Method of passing wires through the tube.*

the same time avoid running wires parallel with others which are indifferent circuits; sacrifice a certain amount of straightness and directness in order to space out the wiring and avoid parallelism of connections which come at all close to each other. Each wire should be sleeved with a piece of systoflex tubing (sometimes called spaghetti), preferably coloured green for filament circuits, red for plate circuits, and yellow for grid. Take care when ordering this tubing to specify the size of wire it is intended for, since one may lose much time trying to push No. 18 wire into systoflex intended for No. 20.

From the point of view of the reliability of the finished instrument it is well worth while to solder *all* connections, even those which might be screwed down under nuts or terminals on the various components. (If you are ignorant of the art of soldering, the first thing to do is to get rid of the idea that it is difficult, and the second is to get *The Wireless World* for January 21st, 1922, and read the article on it therein.) The extra trouble involved is more than repaid by the freedom from faults which results.

COST.

If all the components except the impedance coil and the tuning coil are purchased ready-made, the cost of the amplifier will be in the neighbourhood of £5 10s. This figure can be considerably reduced by making such components as the various fixed condensers and the filament resistances. An economy of about 15s. can be effected by the construction of the condensers, and this course can be recommended, since they are easily made, and their capacities are not at all critical. Suitable dimensions follow:—*Grid condenser*, two plates only, each of one square inch of copper foil, separated by mica and clamped between two pieces of ebonite, 1½ by 1½ ins. $C_3$—Five plates each side (*i.e.*, ten in all) of copper foil, 1 by 2 ins. clamped between ebonite as before. $C_5$—Three plates each side (six in all) same size as for $C_3$. $C_4$—Not less than ten plates each side (20 in all), 2 by 3 ins. of copper foil. For the other condensers mica of 0·002 in. thickness is specified, but it can hardly be used for $C_4$, because the large quantity required would make the con-

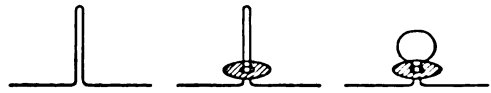

*Fig.* 5. *Showing formation of loop in stages, using a washer.*

denser unduly expensive. Instead, use waxed paper, which will be quite satisfactory and will only cost a few pence. (It is supplied by all electrical stores.)

MODIFICATIONS.

For the benefit of those who may wish to make the amplifier their main receiving unit for all purposes, it may be desirable to indicate the slight alteration necessary to adapt it to their requirements. First, the plate circuit tuning coil should be made large enough to cover waves up to and including 600 metres. This will require about 6 ins. of winding instead of 4 ins. on the 3 in. diameter ebonite tube, whose length should be increased to 7 ins. Two more studs should be added to the ten-point switch, to cover the increase in the size of the coil. For the longer waves a third stud can be added to the two-point switch and a resistance of 80,000 ohms connected to the H.T. positive terminal and the extra stud; this provides an untuned intervalve coupling for use on 1,000 metres and upwards. If a more selective system is desired the tuned anode coupling can be extended to the longer wavelengths by mounting a standard coil socket on the panel and connecting it between the arm of the twelve stud switch and the stud of the three-way switch to which the arm was previously connected. A set of coils can then be used to give long waves, or the short wave coil can be used

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alone by inserting a shorting plug in the socket. The connections of the plate circuit of the H.F. valve will be understood more readily from Fig.7, in which S is the coil socket and R the anode resistance.

OPERATION OF THE AMPLIFIER.

The circuits embodied in the instrument are all of well-known types, and probably do not need any detailed instructions for use. The following hints, however, may be helpful:—First, as to valves. Much depends upon getting a suitable combination, especially in the case of the H.F. amplifier and the rectifier. The latter is the most important valve in the set, so try all the different ones you possess in this position until you are satisfied that you have found the one which gives the best results.

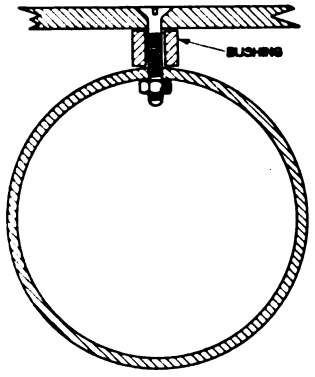


*Fig. 6. One end of the inductance former.*

Make sure that you are using a suitable valve of plate voltage, for if not you may get the condition known as over-lap, which makes satisfactory reception of telephony an impossibility.

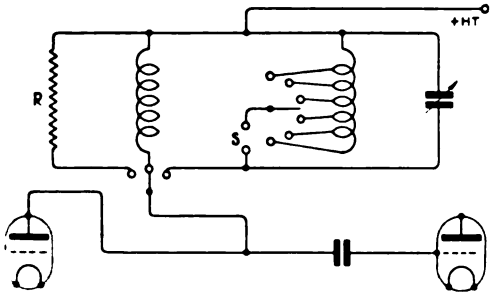


*Fig. 7. Connections of the plate circuit of the H.F. valve.*

The amplifier can, of course, be connected to any type of tuner, but a loose-coupled circuit is strongly recommended, in spite of the difficulty of searching for stations with this type of tuner. Its use will probably be well repaid by the relative immunity it confers from jamming by 450 metre D.F. stations, and should, moreover, be compulsory for the purpose of reducing interference by radiation from sets in the oscillating condition.

# The Wireless Society of London

THE undermentioned Members and Associates of the above Society are requested to communicate their present addresses to the Honorary Secretary, Mr. L. F. Fogarty, A.M.I.E.E., F.R.S.A., Dene Cottage, Manor Way, Ruislip, Middlesex.

It is desirable that this information should be supplied as early as possible, in order to ensure that the next list of members published with the book of rules of the Society should be as complete as possible.

| | |
|---|---|
| Anderson, Major D. B., T.D. | Cove, Dumbartonshire. |
| Beatie, A. S. .. .. | Broadhurst Gardens. |
| Bechtel, G. H. .. .. | Birmingham. |
| Close, C. J. .. .. | Kingsway. |
| Cogger,, H. T. .. .. | Maidstone. |
| Coombes, F. E. .. | Finsbury Park. |
| Dean, A. E. .. .. | Streatham. |
| Ewen H. A. .. .. | Shenfield, Essex. |
| Fletcher, H. .. .. | Hounslow. |
| Green, G. W. .. .. | Feltham. |
| Henderson, H. W. .. | Portman Square. |
| Housden, H. .. .. | South Norwood. |
| Johnson, W. A. .. | Co. Cork. |
| Lewis, H. .. .. | Clapham. |
| Loten, H. S. .. .. | Hornsea, E. Yorks. |
| Lucy, R. M. H. .. | Anerley. |
| Murch, R. W. .. .. | St. Margarets-on-Thames |
| Nickerson .. .. | S. Norwood. |
| Osbon, F. J. .. .. | Dublin. |
| Page, H.B. .. .. | Stoke Newington. |
| Parker, C. .. .. | Purley. |
| Pearce, S. A. .. .. | Clapham Park. |
| Popham, W. W. .. | West Kensington. |
| Rayner, G. E. .. | Brentford. |
| Smith, G. A. .. .. | Northumberland. |
| Smith. Sidney .. .. | Snodland. |
| Tate, A. B. S. .. .. | Chiswick. |
| Taylor, J. A. .. .. | Grosvenor Gardens. |
| Turnbull, G. .. .. | Camden Town. |
| Walker, H. S. .. .. | Crowborough Camp. |
| Whetmore, S. A. H. .. | Bedford Park, W. |

# Telephone Phonetic Alphabet.

Amateurs are recommended to use the following phonetic means of expressing the letters of the Alphabet, which have been found very convenient for keeping distinct those letters which, used in telephony, are sometimes confused owing to their similarity of sound.

| | | | |
|---|---|---|---|
| A | .. Ac | N | .. Nuts |
| B | .. Beer | O | .. Orange |
| C | .. Charlie | P | .. Pip |
| D | .. Don | Q | .. Queen |
| E | .. Edward | R | .. Robert |
| F | .. Freddie | S | .. Sugar |
| G | .. George | T | .. Too |
| H | .. Harry | U | .. Uncle |
| I | .. Ink | V | .. Vic |
| J | .. Johnnie | W | .. William |
| K | .. King | X | .. X-ray |
| L | .. London | Y | .. Yorker |
| M | .. Monkey | Z | .. Zebra |

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# An American Short-wave Regenerative Receiver.*

BY NORMAN A. NYQUIST.

A SUITABLE receiver was required for amateur relay work on 200 to 450 metres, a receiver that gave maximum signal strength and one sufficiently selective to exclude local interference while receiving distant stations.

The following design was adapted from an American Signal Corps interception receiver, and gave excellent results on all wavelengths between 150 and 750 metres. Tuning was very sharp and a pleasing degree of selectivity was obtainable.

Referring to Fig. 1 shows the schematic wiring diagram of the receiver, and it will be noted that the primary circuit consists of the antenna, primary variable condenser, primary variometer, primary coupling coil and ground, all connected in series.

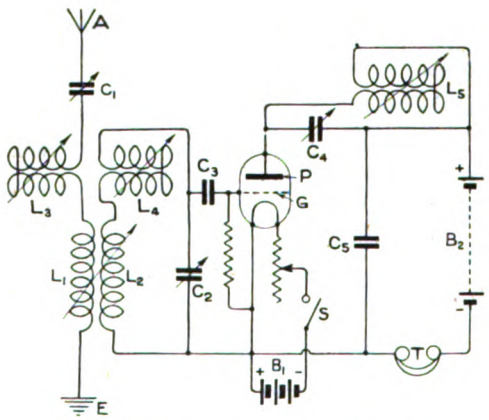


*Fig. 1. Circuit diagram of Receiver.*

The secondary circuit consists of the secondary variometer, secondary coupling coil and secondary variable condenser, all in series. One terminal of the secondary variable condenser is connected to the grid condenser and through the grid condenser to the grid. The other side of the variable condenser runs to the negative side of the filament battery and completes the secondary circuit.

There is a tertiary circuit, making the receiver of the Armstrong regenerative type. This circuit simply consists of a third tuning circuit similar to the secondary circuit, allowing the plate circuit to be tuned, for regeneration or to produce oscillations to receive undamped signals. It will be noted that the tertiary variometer and tertiary variable condenser are connected in parallel. One side of the tertiary variable condenser runs to the plate; the other side runs to the positive side of the high potential battery, and from the negative side of the high potential battery to the telephones, through the telephones back to the negative side of the filament battery. A by-passing fixed condenser is connected across the high tension battery, and telephones to provide a path for the high frequency oscillations which would otherwise be impeded by the high resistance of the telephones and battery. This completes the entire circuit with the exception of the positive side of the filament battery, which should be run through a suitable filament current rheostat to the other filament terminal.

* *Abstract from Radio News.*

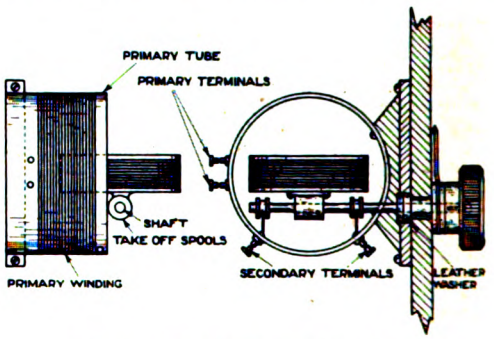


*Fig. 2. The Loose-coupler, showing constructional details.*

Now, in regard to the construction of this receiver and its novel features: the primary-secondary coupler is shown cross-sectionally in Fig. 2 and is shown in the right hand upper corner of Fig. 3. It consists of a fixed tube 3½" in diameter fastened to the back of the panel. On this are wound 10 turns of 3-16 No. 38 Litzendraht wire and then varnished. The movable coil is 2¼" in diameter and is pile wound with 12 turns of wire, six to a layer. From the drawings it will be noted that a 90 degree range of coupling can be obtained from the zero point, and that a 10 degree range of coupling can be obtained in

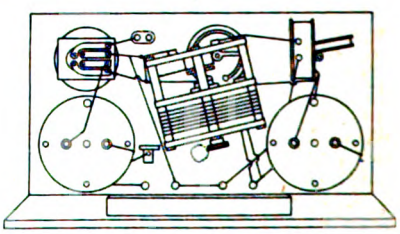

*Fig. 3. Rear view of the set. The secondary variometer and condenser are mounted at right angles to those in the other circuits.*

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the negative position (Fig. 4). This feature is to overcome any fixed primary-secondary coupling that may exist, due to the manner in which the receiver is wired externally.

The most important part of the receiver is the construction of the variometers. These variometers are mounted on the same shaft as the variable condensers. An ordinary variable condenser has a minimum to maximum capacity ratio of two and one-half to one. Likewise an ordinary variometer has a minimum to maximum inductance ratio of two and one-half to one. Placing a variable condenser and variometer in parallel, and both on the same shaft, working from minimum to maximum simultaneously, we get a wavelength range of at least five to one. In the antenna circuit we have a little different condition. The condenser and variometer are in series with the antenna and ground, which is really a condenser, and a wavelength range of only about five to one can be obtained. But in the closed circuits such as the secondary and tertiary circuit, and using specially shaped plates and good variometers, a range of eight to one can be obtained.

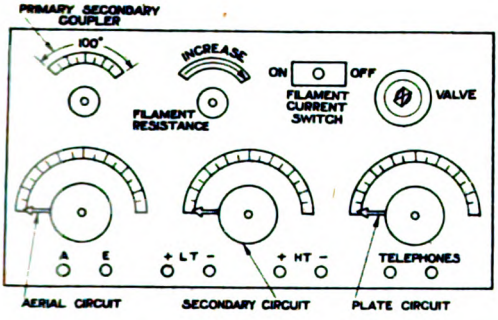


*Fig. 4. Front View of the Receiver in which the Capacity and Inductance of the Circuit are adjusted simultaneously.*

Fig. 5 shows cross-sectionally the construction of a variometer and the manner in which it is attached to the variable condensers. It is seen that one ebonite disc is fastened permanently to the back of the variable condenser by three spacers. This ebonite disc holds the stationary coils of one variometer. Another disc is attached to the variable condenser shaft. Only one take-off pulley is required to bring out one lead of the movable coil. The other lead of the movable coil is connected to the shaft of the variable condenser. The shape of these coils is shown in Fig. 6, which also shows the manner in which they are connected.

To wind these coils, a brass form is made, with the sides removable so as to remove the coils from the form after they are wound. However, before removing the coils they should be dipped in paraffin wax, form and all, and left to cool, so that the coils retain their shape. All the coils are wound with 3/16 No. 38 Litzendraht. The primary coils consist of six turns per coil (four coils per variometer, two stationary and two movable), two turns per layer and three layers. The primary coil has more turns than the other coils, as this variometer is in series with the antenna and antenna condenser and requires more induc-

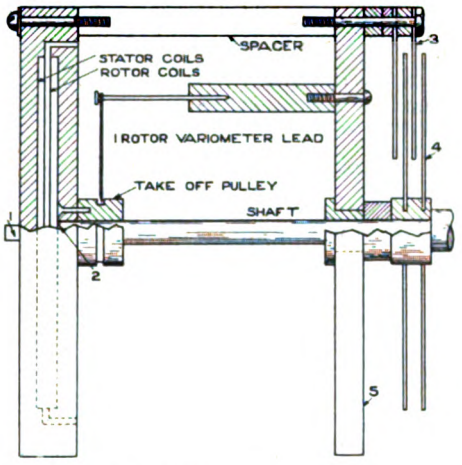


*Fig. 5. Details of Variometer Mounting on the Condenser Shaft.*

tance. The secondary and tertiary variometers have four turns per coil, two turns per layer and two layers. These finished coils are waxed to the ebonite discs, which have previously been machined to the required shape with considerable accuracy, as the forms should not rub during the 180-degree rotation and the face of the movable and fixed coils should be ten-thousandths of an inch apart.

The outside diameter of these coils is just four inches. Fig. 6 shows how to connect the four

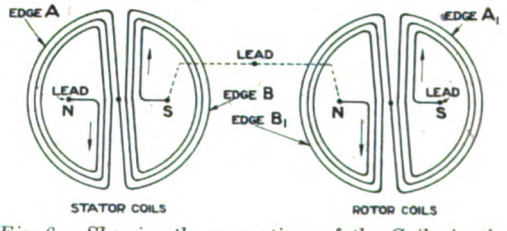


*Fig. 6. Showing the connections of the Coils in the Variometers.*

coils of one variometer so that they assist each other in the proper manner at all points on the scale.

Fig. 7 shows the construction of the grid condenser and by-passing condenser, both of which are fixed units. The grid condenser has four copper plates and five mica plates; the by-passing condenser has eight copper plates and nine mica plates, of sizes cut in accordance with the drawing.

The interior of the receiver is shown in Fig. 3 and

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gives a good idea as to how to assemble the complete unit. Heavy wire should be used for the wiring between units, No. 12 B. & S. bare copper wire, soft drawn, and covered with black empire cloth tubing makes a very neat job. An ordinary valve socket can be purchased and mounted on the front of the panel or behind a window as may be desired and will save the trouble of manufacturing a socket. The filament current rheostat is mounted in the rear of the panel, controlled by a knob and pointer at the front of the panel. A small key or push-switch is mounted to light the filament.

It is noted that the primary condenser-variometer unit is mounted vertically and the other secondary and tertiary units are horizontal. This is arranged in this way to prevent fixed coupling between the primary-secondary, primary-tertiary and secondary-tertiary circuits.

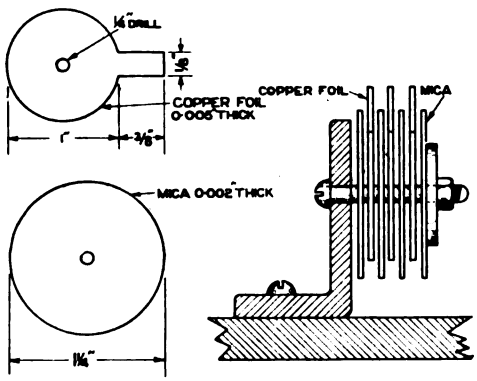


*Fig. 7. Details of the Construction of the Small Fixed Condensers.*

The operation of the receiver requires considerable care for best results. Assume that the receiver is ready for operation, the filament being light and the high potential battery being connected. Suppose that we wish to receive a station of unknown wavelength, then set the tertiary control at zero and the coupling at about 70 degrees. Now work the primary and secondary control simultaneously, starting at zero and working toward 180 degrees. Provided signals are incoming, you will pass points where signals will be heard. Release the secondary control at one of the points and tune the primary control closely. Then tune the secondary control to that same wavelength. Now taking the tertiary control, bring that toward 180 degrees. As you move the tertiary circuits, it immediately starts regenerating and the signal strength will increase gradually. As the signal strength increases with the forward movement, it will finally increase to a point where the tone of the spark being received changes and becomes *mushy*. At that point the regeneration has reached a point which has caused oscillation to start.

If, while tuning to one incoming signal, you are being interfered with by a second or third station, reduce the coupling toward zero, at the same time readjusting the primary and secondary controls. On reaching a point where the one desired station is being received, bring the tertiary control over starting regeneration, at the same time adjusting the coupling control and secondary control. Remember that when you reduce the coupling, you reduce the resistance in both the primary and secondary circuits, but at the same time reduce the amount of energy being transferred. There is a point when maximum signal strength will be obtained for all stations and it will never be at 90 degrees for weak signal when the receiver is properly tuned.

Wireless telephone signals are received just the same as spark signals or other damped types of oscillations. However, inasmuch as this receiver is capable of starting oscillations in itself, it can be used to receive continuous or undamped oscillations as well, on wavelengths of 150 to 750 metres.

The tuning is similar to tuning in spark signals, only the tertiary control must always be sufficiently near the 180-degree point of the scale to have oscillations generating all the time tuning is being done. That is, if your incoming oscillation is 1,500,000 cycles, you tune your set to generate oscillation having a period of 1,499,000 cycles, a difference of 1,000 cycles, and get a corresponding note in the telephones. This oscillation set up in the receiver can be varied by varying the tertiary control and any note desired produced in the telephones from inaudibility to a few cycles a second.

Inability to oscillate may be due to low filament temperature, low high potential battery, low grid leak, the tertiary circuit being improperly connected. To remove the trouble of the telephone cords acting as coupling from the tertiary circuit back through the body to the secondary circuit, the receiver case may be lined with sheet copper, connected to the negative side of the filament battery and grounded. The telephone cord should also be covered with copper braid and grounded as well.

## The Wireless Society of London.

THE Wireless Society of London concluded its last session on June 14th, when an address was delivered by Sir Oliver Lodge, F.R.S., at the Institute of Electrical Engineers.

Although the Society does not hold further general meetings until September, its activities are in no way curtailed, and the names of proposed new members and associates will come before the Committee at their monthly meetings, and all applications passed prior to the first meeting of the next session will be balloted at that meeting.

Under the auspices of the Society, a Wireless Exhibition and Convention is being held at the Horticultural Hall, Westminster, from Saturday, September 30th, to Saturday, October 7th, inclusive. Full details of the Exhibition will be duly advertised. Complete arrangements are being made in connection with the social side of the Exhibition, and the organisers have kindly offered to place at the disposal of the Wireless Society of London a number of complimentary tickets of admission, which will be distributed amongst the members of the Society and affiliated Societies.

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The membership of the Society now stands at close on 600. Country members are admitted at half fee, and there is the grade of Associate Member for those not at present technically qualified in wireless work, but who are interesting themselves in the science. Societies affiliated with the Wireless Society of London now number over seventy, and any new Wireless Society which is being formed or has recently been formed is invited to make application for particulars of the affiliation scheme (if this has not already been done), to the Hon. Secretary, Mr. L. H. McMichael, 32, Quex Road, West Hampstead, N.W.6.

The Society publishes a journal, in which reports of lectures and proceedings of the meetings of the Society are fully dealt with. This journal is distributed to each member and associated member, and to affiliated societies.

Book of rules and application form for membership can be obtained on application to the Hon Secretary.

# Notes

### The Imperial "Chain."

In reply to a question in the House of Commons, Mr. Kellaway said:—"The Government have further considered the question of the Imperial wireless chain, and have decided to erect in England a station of the ultimate power contemplated by the Expert Commission, instead of the smaller power which they proposed should be used in the first instance. The Government are advised that this station will provide especially direct commercial communication with India, South Africa, and Australia. In India, the Imperial Government will erect and the Indian Government will work a station also capable of direct communication with England, South Africa and Australia. As a corollary of this decision the proposed second station in Egypt and the station in East Africa will be deferred; and the question of erecting stations at Singapore and Hong Kong will be reconsidered. Communication is proceeding with the Union Government as to the station in South Africa, and the experts of the Canadian Government are expected to reach England very shortly in order to discuss the participation of Canada in the scheme."

It is reported from Melbourne that the Commonwealth Prime Minister has received from the Secretary of State for the Colonies an outline of the Imperial Government's proposals

He regards the scheme as a complete justification of his attitude at the Imperial Conference in favour of direct communication.

Important modifications have been made in the scheme regarding the smaller links. Four suggested stations have been for the moment cut out. These are Suez Canal, Singapore, Hong Kong and East Africa. But as indicated by Mr. Kellaway, the stations at Singapore and Hong Kong may yet be established at no distant date, and the other two are even now in mind, the question of their erection being only deferred.

### North Atlantic Ice Reports.

Ice reports are issued by the American Hydrographic Office in respect of the movements in the North Atlantic. Information is received from the Coastguard cutter on patrol. The ice-patrol vessel will give ice information at any time to any ship with which the patrol vessel can communicate on 600 metres.

### American Invitation to Correspond.

Mr. George E. Hall, Jr., 17, Emerson Place, Lynn, Mass., U.S.A., will be glad to correspond with a British amateur.

### A Godalming Amateur Station.

The accompanying photographs show the aerial and apparatus of the station erected by Mr. W. G. Fudger, of Godalming. Mr. Fudger commenced his station in January last, and the results shown in the photographs were achieved by the beginning of May.

*Aerial at Mr. W. G. Fudger's Station at Godalming.*

*Interior view of Mr. Fudger's Station.*



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### Mrs. Lloyd George Hears FL.

An interesting feature of the recent tour of the Western Counties by Dame Margaret Lloyd George, D.B.E., was the series of demonstrations of wireless telephony and telegraphy given by Mr. I. Chapman, Associate I.R.E., of Poole, Dorset.

The first and most interesting was given at Clifton Zoological Gardens on July 10th, when over 5,000 people attended the meeting.

A special transmission of music from FL by kind permission of the French authorities was given at 3.45 p.m., and Dame Margaret Lloyd George was an interested listener.

Successive demonstrations were given on following days at "Cumbre," Pennsylvania, Exeter, and Gyllyndune Gardens, Falmouth, when the usual daily telephony transmission afforded much enjoyment to the large gatherings of people.

### An Army Council Decision.

Before distributing the prizes at the half-yearly inspection of the cadets of the Royal Military Academy, Woolwich, the Earl of Cavan, Chief of the Imperial General Staff, stated that he looked to all young officers to obtain a knowledge of wireless.

He was sorry to learn that for financial reasons instruction in the elements of wireless had been dropped. He hoped that instruction might be restored. During the war he was horrified at the number of casualties among men engaged in burying telephone wires, and with the advance of wireless the question arose, "Why not abolish telephone wires?" In this connection the Army Council had decided that from "Division" to the front line there would be no telephone wires in future wars.

### Radio Education at Swansea.

Swansea Technical College is to have installed apparatus costing about £50 for the purpose of a course of telegraphy and telephony. The Education Committee decided to approve of the scheme on the recommendation of the Higher Education Sub-Committee.

### P.M.G. on Broadcasting.

The Postmaster-General said on July 18th, "I have intimated to a committee representing the manufacturers of wireless apparatus in this country the conditions on which I propose to grant licences for broadcasting, and I understand these proposals will be submitted to the general body of manufacturers forthwith. I have informed the manufacturers that in the event of their supplying the capital required and providing efficient broadcasting services, I will agree that the apparatus which it will be permissible to use under the Post Office licence for the reception of these services shall for two years be restricted to apparatus manufactured in Great Britain."

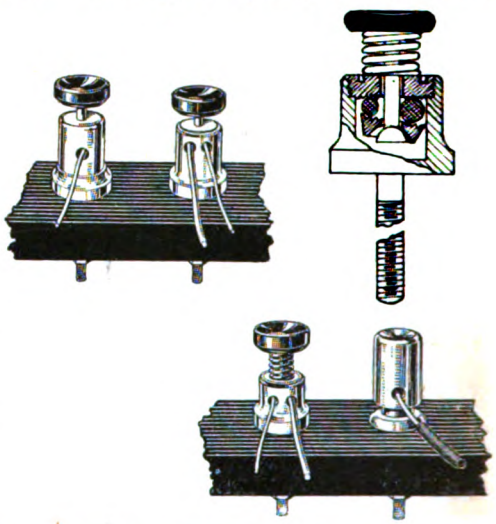
In reply to a question as to whether he had power to do what he proposes, Mr. Kellaway said: "The power is given me by this House to issue licences, and it is inconceivable to me that we should allow a new form of communication in this country to be exploited by foreign manufacturers."

Captain W. Benn asked, "Is not the right hon. gentleman taking advantage of the powers of licence to impose a protective system in this hole-and-corner way?" to which Mr. Kellaway replied, "No, not a protective system, but a proper method of protecting a new means of communication in this country."

Replying to Sir H. Brittain, Mr. Kellaway said: "A site for the proposed high-power wireless station has been selected provisionally. Its final adoption depends on the result of certain inquiries which are now in progress." He could not give a date for installation.

### A New Type of Terminal.

The accompanying illustration shows a new type of terminal which is shortly to be placed on the market. This terminal has distinctive features which should appeal especially to experimenters



who require to make constant and rapid changes in connections.

Instead of gripping the lead by screw-applied pressure, the new terminal grips by means of a spring, as indicated in the section illustrated. Various types of these terminals are made, some only being illustrated here. They are being made in both nickel and lacquered brass finish and with ebonite caps as shown.

### Transmitting from a Racing Car.

A very interesting wireless experiment was conducted recently by Mr. Colin Gardner in connection with Mr. S. F. Edge's world 24-hour speed record with a Spyker car.

A wireless set was installed on the car, the total time available for the equipment being only one minute 45 seconds. Mr. Gardner was successful in transmitting messages from the car whilst travelling at a speed of 85 to 90 miles an hour.

### Wireless Patent Action.

An action has been brought by Messrs. Marconi's Wireless Telegraph Company, Ltd., against Messrs. The Mullard Radio Valve Company, Ltd., for alleged infringement of valve patents. At the time of going to press, the hearing is proceeding.

### K.B. Units.

It is regretted that in the advertisement of K.B. Units, which appeared on page vii of the

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July 22nd issue, the numbers relating to the units were misplaced.

**The Hague Concerts on Inceeased Power.**

It is announced that the *Daily Mail* and *Evening News* have entered into an arrangement with the organisers of the Hague Concerts, to support the latter financially so as to ensure the continuance of the transmissions with an increase of power. The transmissions of concerts between 7 p.m. and 8 p.m. on Thursdays and Sundays, will accordingly take place. On Thursday, 27th, the power used will be 800 watts, and by the following week this will be increased to 1½ k.W.

**Transmission by 2 LO (Marconi House).**

The Marconi Company hopes to transmit from 5 p.m. to 6.30 p.m., and again at 9 p.m. on July 29th. This Company will appreciate criticism by amateurs of the transmission of telephony by their station **2 LO**, and expresses willingness to endeavour to advise those amateurs who care to send stamped addressed postcards in advance, of the times of their transmissions.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have from time to time seen correspondence in your columns dealing with harmonics radiated from various high-powered stations such as **GBL, GSW, GKU**, etc., and I have often wondered at what distance these could be heard. Much was my surprise when, on **July 9th, at 2210 BST.**, I heard Barcelona (**EAB**) call **ICI**, when listening in on a wavelength of 430 metres. At the time I was using 4 valves, 2 being H.F. and 1 a note magnifier, and with these valves on an aerial 22 ft. high **EAB** was very strong. I switched off to one H.F. and one detector only, and he was still readable. Having heard **EAB** on several occasions on a wavelength of about 4,300 metres C.W., I quickly changed to this, and was much astonished when, with all four valves again, he was only slightly louder than the harmonic, which was probably his tenth harmonic. I searched, both above and below the true wavelength, for other harmonics of **EAB**, but the one on 430 metres was the only one I could hear. I also heard him some days previously on 430 metres calling **POZ**, but it was at the end of his message, so that I did not get a chance to follow the thing up. **EAB** is 850 miles away, so that I should think clear reception of his message on one-tenth of the true wavelength is somewhat strange. There was no fading or variation of the signal whatever. It was just dusk at the time, but, so far as I can remember, the reception of this harmonic on the previous occasion mentioned, took place in daylight. I have also noticed several nights recently, when it was just dark, that S. Maries-de-la-Mer (**FFS**) came in as loud as Liverpool (**GLV**), both being on 600 metres spark, and the distance from the former being 800 miles, while the latter is only 30 miles away, both of these stations being readable at a distance from the telephones. I should be pleased to hear of other similar experiences which have no doubt occurred to many readers of *The Wireless World and Radio Review*.

B. L. STEPHENSON.

# Calendar of Current Events

**Saturday, July 29th.**

Hounslow and District Wireless Society. Demonstration at Hounslow Hospital Fête.

**Sunday, July 30th.**

Transmission of Telephony from 7 to 8 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, August 1st.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

**Thursday, August 3rd.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

HACKNEY AND DISTRICT RADIO SOCIETY.
8 *p.m.*, at 111, Chatsworth Road, Clapton. Meeting.

**Friday, August 4th.**

SOUTH SHIELDS Y.M.C.A. AMATEUR WIRELESS SOCIETY.
8 *p.m.*, at Y.M.C.A. Buildings, Fowler Street, South Shields. Meeting.

**Sunday, August 6th.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, August 7th.**

SOUTHEND AND DISTRICT WIRELESS CLUB.
Garden Fête in the Rectory, Leigh-on-Sea. Public Demonstration.

**Tuesday, August 8th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

**Thursday, August 10th.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

ILKLEY AND DISTRICT WIRELESS SOCIETY.
7 *p.m.* at Regent Café. Meeting.

STOCKTON AND DISTRICT AMATEUR WIRELESS SOCIETY.
Monthly Meeting.

HACKNEY AND DISTRICT RADIO SOCIETY.
8 *p.m.* Meeting.,

**Friday, August 11th.**

SOUTH SHIELDS Y.M.C.A. AMATEUR WIRELESS SOCIETY.
8 *p.m.*, at Y.M.C.A. Buildings, Fowler Street, South Shields. Meeting.



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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, E. Finchley, N.

On Friday, July 7th, Mr. J. Stanley gave the fourth of his series of lectures on the theory of wireless telegraphy and telephony, dealing this time with detectors and telephones.

He first of all showed why signals could not be detected by simply connecting telephones in the receiving circuit, and explained that it was necessary for the high frequency oscillations to be rectified and converted into low frequency pulses. He then described how a crystal detector performs the function of rectification and explained the meaning of the characteristic curve of various crystals. In this connection he pointed out that in order to get certain crystals to work at the best point of their curve for rectification purposes, it is necessary to apply across them a steady voltage, and he showed how this could be done by means of a potentiometer and a small cell.

Mr. Stanley went on to deal very carefully with the construction and action of the telephones, mentioning specially the Brown telephones, and described also the action of the blocking condenser usually connected across the telephone terminals. Finally he showed the advantages in increased selectivity, which could be obtained by using loose coupling between the aerial and a closed circuit instead of coupling direct on to the aerial.

This proved to be one of the most interesting of Mr. Stanley's lectures and he was followed throughout with great interest, a very hearty vote of thanks being given him at the conclusion.

On Saturday, July 8th, the Society gave a demonstration at a garden party held by the Hornsey Branch of the National Council of Women of Great Britain and Ireland at The Grange, Highgate. A number of special transmissions from London amateurs were arranged, and in addition the transmissions from Marconi House and **2 FQ** to other fêtes were picked up. Owing to the wet weather the demonstration could not be given on the lawn as was intended, but two leads about 100 yards long were taken from the receiving set to the hall of the house, where a loud speaker (kindly lent by Messrs. Brown) was placed, and a large number of people had the pleasure of listening to some excellent music by radio.

The Hon. Secretary will be pleased to answer enquiries regarding the Society and to give particulars of the series of lectures now being held.

## The West London Wireless Experimental Association.*

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

At the meeting held on Thursday, July 6th, a fairly good attendance was made. Mr. F. E. Stadt continued his paper, "Interpretation of Wireless Circuits." In the course of his lecture he dealt with several "freak" circuits, and by diagrams on the blackboard showed how they could be illustrated to the best advantage for ease of interpretation. A very hearty vote of thanks was duly accorded the Vice-President for his instructive lecture.

The Commmittee hope, almost immediately, to arrange a half-hourly lecture at each weekly meeting for the benefit of the large number of new members who are not yet greatly acquainted with the science of radio-telegraphy and telephony. The Association is still adding to its apparatus and this will prove a very great help to its members.

A meeting was held on Thursday, July 13th, members attending in strong numbers. The Morse practice class was well attended and it is hoped that the new pattern buzzer recently presented by Mr. J. F. Bruce will have plenty of exercise. New members will be glad to learn that Messrs. J. F. Bruce and R. Cole have offered to give 20 minutes at each meeting to the explanation of construction of apparatus for beginners' use, so that by the time the members desiring this knowledge have attended a few of these classes they will be able to construct their own receiving sets.

Mr. F. E. Stadt, the President, again gave a paper, "Paul's Compact Crystal Receiver." After a full description of the apparatus and the inspection of same by the members, a very fine lecture was given. The dimensions and data of the windings of the coils, description and measurements of the crystal detector and condenser, together with the very little necessary alterations to make the set capable of tuning up to 600 metres, was very interesting and instructive. The lecturer then, by diagrams, showed how simple it was to alter the set to a one-valve amplifying and crystal rectification circuit. At the conclusion of the Vice-President's remarks a very hearty vote of thanks was accorded him, with much applause.

On July 20th a lecture was given on "A Three-Valve Variometer Circuit," by Mr. F. E. Stadt.

Information regarding the objects, subscriptions, etc., will be gladly given by the Secretary.

Club-rooms: Belmont Road Schools, Chiswick, W.

## Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds. A general meeting was held on Friday, July 14th, at the Leeds University, Mr. G. P. Kendall, B.Sc. (Vice-President), taking the chair at 8 p.m. The Chairman called upon the Hon. Secretary to discharge certain business, which included an announcement to the effect that as a result of a meeting of the Committee, it had been decided that any person

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who is elected to the membership of the Society during the course of the remainder of this sesson, shall be entitled to all the benefits attached to the membership for that period, upon receipt of entrance fee of half-a-crown. The Chairman then called upon the Hon. Secretary to deliver a paper on the subject of "Maritime Wireless Communication."

The lecturer commenced his paper with a consideration of the great advantages that were resultant upon the installation of wireless apparatus at sea, and briefly reviewed the very many facilities that such apparatus readily presented. The subject was outlined historically from the day when Marconi installed his plant aboard the Italian cruiser "San Martin," exactly twenty-five years ago to the day, through the progressive years that followed, until the present day, when wireless has become almost an essential part of a vessel's equipment. The various apparatus used from the very first days of marine wireless, down to the plant as used nowadays, were described practically and theoretically with the aid of diagrams, which were distributed to the meeting. On the transmitting side, such apparatus as the plain aerial and tuned aerial sets using induction coils; power sets having fixed, rotary or quenched spark gaps, using low frequency alternating current; continuous wave valve transmitters using rectified L.F.A.C. were considered, and some actual working ranges as may be obtained with such sets were submitted to the meeting. Receiving gear was treated in a similar manner, various apparatus, including the magnetic and crystal detectors, valve and crystal circuits, low frequency valve magnifiers, separate heterodynes to enable the reception of continuous waves to be carried out, complete three-valve receivers, and single four-electrode valve circuits being described. The performance of such apparatus was also considered, and a brief sketch of marine wireless and direction finding work then followed. At the conclusion of the lecturer's remarks a discussion was opened by the Chairman, and various points relating to the valve sets were considered at length. Following upon the discussion, numerous lantern slides, kindly loaned by Marconi's Wireless Telegraph Co., Ltd., Radio Communication Co., Ltd., R.M. Radio, Ltd., and Mr. N. Whiteley, were exhibited and were a great aid to the lecturer, and the meeting especially from the practical point of view.

After a vote of thanks had been accorded to the Hon. Secretary, the meeting was declared closed.

### Wireless Experimental Association.*

Secretary, Mr. Geo. Sutton, A.M.I.E.E., 21, Troughton Road, Charlton, S.E.7.

On July 5th a very interesting evening was spent, and so great has the membership become, that late arrivals found accommodation difficult.

Mr. Hersey's description of his receiver was very interesting, especially as he gave detailed constructional information. Mr. Voigt described the many characteristics of valves, and their relative inefficiency as detectors.

The meeting held on July 12th was better attended than the previous weeks, and before long, larger accommodation will be necessary. This is convincing proof of the success of the recruiting campaign instituted not so long ago. The Chairman began by illustrating the various symbols used in electrical work. Many really simple signs were not easily recognised, especially a terminal, an arc, a selenium cell, a nodon valve and a fuse. This chat proved very interesting, as over 50 symbols were shown. During the second half, the Secretary exhibited and described many different pattern valves, including some very old and unknown types, and even an up-to-date four-electrode valve of foreign origin.

The Secretary is still waiting to hear from some more new members and will deal with any enquiries at the address given above.

### Radio Experimental Association (Nottingham and District).*

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A meeting of the above Association was held in Room 74, Mechanics' Institute, at 7.30 p.m. on Thursday, June 29th.

Mr. Pritchett, who had consented to lecture during the evening, delivered his remarks with marked ability. The subject, "Functioning of Valve Circuits and Their Components," proved one of great interest. He dealt with the various parts of a valve receiver, showing clearly the way in which each worked, and also explained fully how it was possible to obtain the very best out of one's set. As usual, in a lecture of this description, the audience had before them "Characteristic Curves," and Mr. Pritchett explained how very essential it was to understand the particular characteristics of each valve in use. The lecturer also plotted an actual curve relating to a valve he had brought with him. He did not use any expensive apparatus, but only such as might be seen lying around any average amateur's receiving set, and the only piece of apparatus which could not be said to be home-made was a milli-voltmeter.

This demonstration was greatly appreciated by the members present.

During the evening Mr. Ley demonstrated the working of a "Lokap Lattice Coil Winder," and also exhibited a set of coils he had wound. This machine is for the use of members who pay a small nominal sum for the loan of it.

Full particulars will be supplied on application to the Hon. Secretary.

### The Southend and District Wireless Club.

Hon. Secretary, Mr. D. L. Plaistowe, 21, Oakleigh Park Drive, Leigh-on-Sea.

A general meeting was held at Headquarters, 51, Queen's Road, Southend-on-Sea, on June 30th.

Mr. Mayer took the chair. The minutes of the previous meeting were read and approved, and the Secretary's report dealt with.

A general discussion followed on topics of interest to members, and several interesting points were raised and disposed of by various members, after which the Chairman called upon Mr. Plaistowe to give the second of a series of lectures of an elementary nature for the benefit of the non-technical members.

The properties of oscillating circuits were enlarged upon and capacity and inductance, etc., were explained by analogy and also by means of the splendid diagrams provided by Mr. Jagged.

The lecturer was accorded a hearty vote of thanks, after which Mr. Mayer showed an extremely small and compact one-valve receiver that he had made out of odds and ends when in the Service,

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and that could be packed up in the kit bag. A short description of the set was given.

The Club was represented at a Garden Fête at Leigh Rectory on Saturday, July 8th, and a good show of apparatus was arranged by members.

Successful results were obtained on the portable receiver, which, though not complete, as only three L.F. coupled valves were used instead of the two H.F. rectifier and two note magnifying valve, with which the set will be provided, gave loud and pure speech with "Brown" microphone relay and loud speaker.

Short lectures were given to the people, and during the intervals of telephonic transmissions from **2 LO**, and also **2 LZ** and **2 WW**, a high speed Morse operator read some of the ship stations.

One lady endeavoured to put on a pair of headphones while wearing a large hat, and was prevented in time from breaking the headband in trying to stretch it. In a case like this it was considered that elastic or other expandable material might be used.

The next public demonstration will take place on August Bank Holiday at the Garden Fête in the Rectory, Leigh-on Sea, when we hope to have a good exhibition of apparatus.

Those interested should communicate with the Hon. Secretary.

### The Radio Scientific Society of Manchester.

Hon. Secretary, Mr. H. D. Whitehouse, 16, Todd Street, Manchester.

An enjoyable outing was held by the above Society at Prestbury, near Macclesfield, on Saturday, July 15th. During the afternoon an aerial was erected and a five-valve amplifier brought by Mr. Halliwell was installed. Strong signals were received from ships and coast stations. Punctually at 4 p.m. Mr. Lewis (**2 AY**), of Sale, was heard calling up, and this was followed by a musical programme. Unfortunately, considerable interference was experienced. Certain portions were received clearly, the music and speech being excellent.

After taking tea at a neighbouring farm, about a dozen members and friends persevered with an additional three-valve set, but were only able to hear snatches of music and singing in the intervals between the Morse signalling from numerous spark stations In spite of the "jamming," the afternoon was voted a success by all who participated.

Although during the summer months the Society's efforts have been somewhat curtailed, it is hoped that anybody interested in amateur wireless will not hesitate to communicate with the Hon. Secretary, who will be very pleased to answer any enquiries at the above address.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society was held on Wednesday, July 12th, a large attendance of members being present.

An interesting demonstration and lecture will shortly be given by Dr. Norman Aldridge, X-ray specialist of the R.S.H. & S.H.; who, by the way, is a member and a regular attendant at the Society's meetings.

The Society continues to enrol new members. Large attendances are being recorded, but there is still room for more. The Hon. Secretary will be pleased to furnish all particulars.

### The Belvedere and District Radio and Scientific Society.

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

The inaugural meeting was held on Friday, July 14th, at the Erith Technical Institute, at which about 50 people were present.

Mr. T. E. Morriss took the chair at 7.30 p.m. in the absence of Mr. J. F. Watson, who was unfortunately called away on business at short notice.

Mr. A. G. Warren, who explained the desirability of forming a Radio and Scientific Society at the present time, was followed by the Chairman, who outlined the objects and constitution of the Society. Both speakers were then thanked by all present for their most interesting addresses, after which the following officers were elected:—President, Mr. J. F. Watson; Vice-Presidents, Mr. T. E. Morriss, Mr. W. Neagle, B.Sc., A.M.I.Mech.E., Mr. J. C. Williams, A.M.I.E.E.; Hon. Technical Adviser, Mr. A. G. Warren, M.Sc., M.I.E.E., F.Inst.P.; Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent; Hon. Treasurer and Equipment Engineer, Mr. S. Burman; Committee, Messrs. R. L. Chantrill, W. F. Ellis, S. W. Hurst, A.I.E.E., A.Fel.Aer.Inst., C. Morriss, L. W. Scudder, A.M.I.C.E., W. A. Selfe, H. H. Smith.

The necessary business was carried through successfully, and it was decided to hold the first general meeting on September 8th next.

All interested are requested to obtain particulars from the Secretary

### Halifax Wireless Club and Radio Scientific Society.

Hon. Secretary, Mr. Louis J. Ward, Clare Hall, Halifax.

The third annual meeting of the club was held on Wednesday, July 3rd, 1922. About 50 members were present under the Presidency of Mr. Walter Emmott, M.I.E.E., M.Inst.C.E., M.I.Cons.E. The President briefly reported on the past session and congratulated the members on the success achieved. The Treasurer's report showed that the club was sound financially.

The election of officers was as under:—President, Mr. W. Emmott; Vice-Presidents, Messrs. J. R. Clay, A. H. Gledhill, G. E. Rawling, H. Mortimer.

The ballot for membership of the Committee resulted in Messrs. W. R. Haswell, J. H. Hardy, W. J. Holroyd, H. Town, W. Scott, and T. P. Brennan being elected. Mr. J. R. Clay was re-elected Hon. Treasurer and Mr. L. J. Wood, Hon. Secretary. The Technical Committee, consisting of Messrs. J. R. Clay, J. E. Mitchell, H. Mortimer, and L. J. Wood, was re-elected.

Many members spoke in enthusiastic terms of the progress of the club, particular reference being made to the petition to the Postmaster-General, which was inaugurated by the club, and taken up by the London Society, which resulted in the weekly transmission of telephony from Writtle, and which has proved to be the forerunner of the present broadcasting scheme.

The rules of the club, which have been brought up-to-date by the Committee, were approved. Membership of the club is now sub-divided into

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two sections. Full membership is only open to British subjects over 21 who have held a P.M.G. licence for 12 months, or who in the opinion of the Committee possess exceptional technical ability. British subjects under 21, or who have not held a P.M.G. licence for 12 months, will be admitted as Associates. Associates will have the full benefit of the club, but will not be able to take any active part in the management, or vote at meetings.

It has been decided to open the club-room each Monday, Wednesday and Friday, from 7.30 p.m., when an efficient steward will be in charge of the instruments. Members and others interested are invited to attend on these evenings with their difficulties, but non-members are not expected to attend more than once per month.

The instruments belonging to the club have been overhauled by the Technical Committee, and the club now possesses very efficient transmitting and receiving apparatus. In the event of broadcasting becoming an accomplished fact, the room will be open nightly, but due notice will be given of this.

If any amateur in Halifax and district who is not a member wishes to enjoy the advantages of the club, there is still room for a few more members or associates, and full details of the club will be supplied on application to the Hon. Secretary.

### Warwick School Wireless Society.

Secretary, Mr. P. Wintham, Warwick School.

A wireless society for members of Warwick School is in the process of formation to carry on the work of the Wireless Section of the Natural History Society, in view of the impetus given to the study of the subject during the last few months.

The School has had a receiving station for well over two years, and on its recent excursion to Edge Hill, the Wireless Section took a small two-valve portable set, which is shown in the accompanying hotographs.

*Portable Set used by Warwick School Society. The aerial is seen attached to the tower in rear.*

The set was erected and signals were being received within ten minutes of arrival. Eiffel Tower telephony and music were heard very distinctly, while STB, and, of course, GKU, GBL and many other stations came in well, and this despite the fact that the aerial was only about two feet six inches high at the lower (lead-in) end, while the earth was a nine-inch iron rod. Moreover, the set was placed by the highroad, which did not make it any easier to hear speech.

*Warwick School Society's Portable Set in use.*

The set taken was a two-valve resistance-capacity amplifier, using "Burndept" coils and Mullard "Ora" valves, and was placed in an old Mark I aircraft tuner case. It was put together quite hurriedly in the school.

The situation of the set on Edge Hill was very interesting, as it overlooked the famous battlefield, while the upper end of the aerial was attached to the well-known Edge Hill Tower.

### The Durham City and District Wireless Club.

Hon. Secretary, Mr. Geo. Barnard, 3, Sowerby Street, Sacriston, Durham.

The first meeting of the above took place on Tuesday, July 11th. The attendance exceeded all expectations, as also the enthusiasm displayed. In the absence of Mr. Morsen, Mr. Sargent very ably carried out the duties of Chairman.

Before proceeding to business, Mr. Barnard gave a few explanatory remarks, and also outlined the objects of a wireless club. A very interesting discussion then took place, which ended in the Club being formed, the name being as above

It was decided to hold meetings every fourteen days, on the Fridays, at 7 p.m. A committee was then elected, consisting of the Rev. Perkins, of Shadforth, Mr. Brown, of Sherburn Hill, Mr. Nurthen, of Durham, Mr. Clark, of Chester-le-Street, Mr. Sargent, of Durham, Mr. Kelly (Hon. Treasurer), of Durham, and Mr. G. Barnard (Hon. Secretary), of Sacriston. It was decided to let the Presidency, Vice-Presidency, also Chairman, stand over for a few weeks.

The next meeting took place on Friday, July 21st, at 7 p.m., in the hall of The Rose and Crown Hotel, when the Rules and Regulations

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were read, after which a lecture was given by Mr. Geo. Barnard, on "The Electro-Magnetic Theory and its Application to Wireless."

The Secretary wishes to thank the many brother secretaries who have so kindly sent letters of advice, thereby greatly helping to set the new club upon a sound foundation. He will also be very pleased to hear from anyone interested in radio who is desirous of joining the Club; better still, to attend personally the next meeting.

**Barnsley Amateur Wireless Association.**

Hon. Secretary, Mr. G. W. Wigglesworth, 13, King Edward Gardens.

A general meeting of the Barnsley Amateur Wireless Association was held on Tuesday, July 11th, in the Guild Room of the Co-operative Education Department, Market Street.

The question of permanent headquarters was freely discussed and suggestions from the members present were considered, with the result that the Association is very hopeful that at a very early date some of the proposals brought forward will materialise and that the work of the Association will commence in earnest.

The annual subscriptions were fixed as follows:—Adult members, 10s.; age 18 to 21, 7s. 6d.; junior members, 5s.

The existing Committee was re-elected en bloc, viz.:—Mr. G. W. Wigglesworth (Secretary); Mr. J. A. T. Carr (Treasurer); and Messrs. C. Pickering, Crossley and Harding; with the following additions:—Messrs. Smith, Hattersley, Roseveare, Lewis and Rhodes, whilst Mr. C. Pickering was subsequently elected as Chairman.

The question of President, Vice-Presidents, etc., was then discussed, and finally left in the hands of the Committee.

In conclusion, a vote of thanks was passed to the local Co-operative Education Department for the loan of the room for this meeting, and also to the Chairman of the evening's proceedings.

The meeting was then declared closed and new members were enrolled.

There were upwards of 40 members and prospective members present, and judging by the liveliness of the proceedings and the interest displayed, the future success of the Association is assured.

Intending members are requested to communicate with the Secretary.

**Walthamstow Amateur Radio Society.**

Hon. Secretary, Mr. R. Cook, 49, Ulverstone Road, E.17.

At the meeting of the above Society, held at its Headquarters, Y.M.C.A., Church Hill, Walthamstow, E.17, on Wednesday, July 12th, a very interesting and enjoyable evening was spent. After the usual informal discussion between members, business of the Club was commenced; minutes of the last meeting were read and approved. Three new members were admitted to the Club, bringing the total up to 45 members.

Mr. Butler gave an interesting lecture (for the benefit of the more elementary members of the club), on how to make a crystal set, and demonstrated on the blackboard how to construct and wire same.

The Secretary invites any gentlemen interested in radio telephony to join the Society, which will give them most valuable help.

A public demonstration was announced at the above address on Tuesday, July 25th, at 7.30 p.m.

All applications for membership and terms of subscription, together with the objects of the Association, will be immediately replied to by the Secretary.

**Gravesend Wireless Society.**

Communications for this Society should be addressed to the Hon. Secretary, pro tem., Mr. W. C. Birchall, Kirbydene, 29, Pier Road, Rosherville, Gravesend, and not to the Globe Hotel, as hitherto.

**Midland W. Herts. Wireless Club.**

Hon. Secretary, pro tem., Mr. J. R. Francis, Ivy Cottage, Redbourn, Herts.

Correspondence from all willing to assist in the holding of meetings in St. Albans, Harpenden, Hemel Hempsted and Berkhamsted, in connection with this new Club will be welcomed by the Secretary.

**Hyde Amateur Radio Society.**

Secretary, Mr. A. Stainthorpe, 5, Cheapside, Hyde.

The Society now boasts of about a dozen members. A meeting was held on Wednesday, July 5th, at the Flowery Field Hotel, and a discussion was held on the design of the forthcoming two-valve set, many good suggestions being given.

A series of lectures are to be delivered shortly.

**Clapham Wireless Club for Boys.**

An endeavour is being made to form a wireless club for boys in the Clapham and Stockwell districts. Mr. E. J. Valencia, 34, Stockwell Road, S.W.9, is willing to receive the names and addresses of those interested.

**The "Radio Rendezvous."**

Secretary, Mr. W. F. Fuller, Club address.

Amateurs in the districts of East Ham, Manor Park, Wanstead, Ilford, Forest Gate and Barking, are cordially invited to join the above club. The club rooms, 709, The Broadway, Manor Park, E. 12, are open until 10 p.m. daily, except Sunday.

**Sutton and District Wireless Society.**

Hon. Secretary, Mr. E. A. Pywell, "Stanley Lodge," Rosebery Road, Cheam, Surrey.

Although this is a comparatively new society, it is doing remarkably well and has already twenty members. There must be many other wireless experimenters in the district, however, who are still working on their own, and it is hoped that they will now come along and join forces in this society. In this way they will contribute to its success as well as get the advantage of each other's experience.

Full particulars and application form for membership may be obtained from the Hon. Secretary.

**Bridlington and District Wireless Society.**

A wireless society for Bridlington and district is being formed. The undermentioned gentlemen would like to get in touch with those in and about Bridlington who are interested.

It is requested that communication be made with any of the gentlemen whose addresses are given below as soon as possible, who will gladly receive suggestions so that a society may be formed with little delay and of the most benefit.

Mr. O. Tholander, "Cliffcote," South Cliff, Bridlington; Mr. Norman E. Haigh, 24, St. John's Avenue, Bridlington; Mr. M. Horspool, "Darley," Marton Road, Bridlington.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, The Wireless World and Radio Review, 12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"A.B.C." (Leicester)** *asks* (1) *Whether the making up for his own use of various apparatus to circuits which contain patented features renders him liable to action for infringing the patents.* (2) *If he will be allowed to sell similar sets to friends.*

You may make up sets for your own experimental use without rendering yourself liable, but you must not make up sets for any commercial or similar use, and by the sale of such sets, both you and the purchaser would immediately become liable.

**"F.A.G." (S.W.1)** *gives details of coils and windings and asks* (1) *The wavelength range.* (2) *Winding data for a frame aerial to fit the lid of a Mark III tuner case.* (3) *Details of a five-valve circuit with switching arrangements for two, three, four and five valves.*

(1) You apparently wish to use a frame aerial set. If so, coils may be used to load up the frame, as many as required at any time being connected in series with it. The arrangement would not be very efficient, and we do not recommend using these coils at all. (2) Wind about 120 turns of No. 28 in a single layer on a former of the required size with tappings at 3, 6, 15, 30 and 60 turns. (3) See Fig. 3, page 31, April 1st issue. The range would be about 8,000 metres, with a 0·002 mfds. condenser.

**"G.R.G." (Marlborough)** *wishes to construct a Johnson & Rahbek loud speaker, and asks various questions about same.*

(1) Distortion would be introduced in this arrangement from the telephone diaphragm employed. (2) Yes, but this arrangement might be found less sensitive. (3) The windings would depend on the input winding of the amplifier. If L.R., make the primary 4 ozs. of No. 32; if H.R., 2 ozs. of No. 44. For the secondary use 4 to 6 ozs. of No. 44.

**"E.D." (Birmingham)** *asks* (1) *What is the longest distance telephony can be heard with head telephones, and the longest distance with Brown's loud speaker.* (2) *Details for making a set.* (3) *If the seven-valve set in "Amateur Valve Stations," page 14 is suitable for long and short distance telephony.* (4) *Would Brown's type A head telephones, wound with 4,000 ohms, be best, and the loud speaker wound for the same.*

(1) It depends entirely on the power of the transmitter and the sensitivity of the receiving set. Under favourable conditions telephony is possible across the Atlantic. (2) It is impossible to answer this without a more definite statement of requirements. Many good circuits have been given in these columns, almost any of which would serve your purpose, but we should recommend studying a textbook on the subject before starting to make a set. (3) The set referred to is quite unsuitable for your use or construction, and moreover it has no tuning circuits. It is purely a commercial amplifier. A three-valve set would be quite sufficient for your purpose. (4) 4,000 ohm telephones O.K. The loud speaker can have any standard high resistance telephones.

**"P.R.T." (Southport).**—(1) and (3) The circuit is incorrect; see Fig. 1, page 303, June 3rd issue, and many other recent diagrams for the correct arrangement of the valves. (2) About 0·0002 mfds. for short waves. (4) Not essential, but convenient if a large range of wavelengths is to be covered.

**"J.E.W." (Berkhamsted).**—The information you give is rather sketchy, and there is nothing to indicate why the circuit will not work. The diagram submitted is correct. We cannot give the wavelength range as you do not say the size of your inductance former. The capacity of the variable condenser is approximately 0·0003 mfds.

**"W.C.A." (Plymouth)** *asks* (1) *Why a single valve set gives no results.* (2) *Whether an indoor aerial of wires 17 ft. long under the roof would be satisfactory.* (3) *If an outdoor aerial 35 ft. long and 20 ft. high, somewhat screened, would be better than the aerial above.*

(1) We cannot say without more information. Your circuit may be wrongly connected, or have some accidental disconnection, or the valve may be defective, or see below. (2) The aerial is very poor and unlikely to give much except on a three or four-valve set. (3) Considerably better, but better still would be required for really good results.

**"NUMBERS" (Paddington)** *asks for winding data for tuning coils for various wave ranges with aerials ranging from 90 to 110 ft.*

It is impossible to predict sufficiently accurately to distinguish between such aerials, as the gauge of wire, height above ground, etc., would affect results considerably. The figures given must be

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taken as approximate only. Reaction coil should preferably be small enough to slide inside A.T.I. Say, A.T.I. 2″ diameter; reaction coil, 1½″; wire being No. 28.

| λ | A.T.I. | R |
|---|---|---|
| 180 | 25 | 40 |
| 400 | 50 | 50 |
| 440 | 55 | 50 |
| 1,000 | 180 | 100 |
| 1,050 | 200 | 100 |

**"C.B." (Cardiff)** *sends diagram of set and asks for a variation adding further valves.* (2) *If his present connections would be suitable for* **2 MT** *and* **PCGG.**

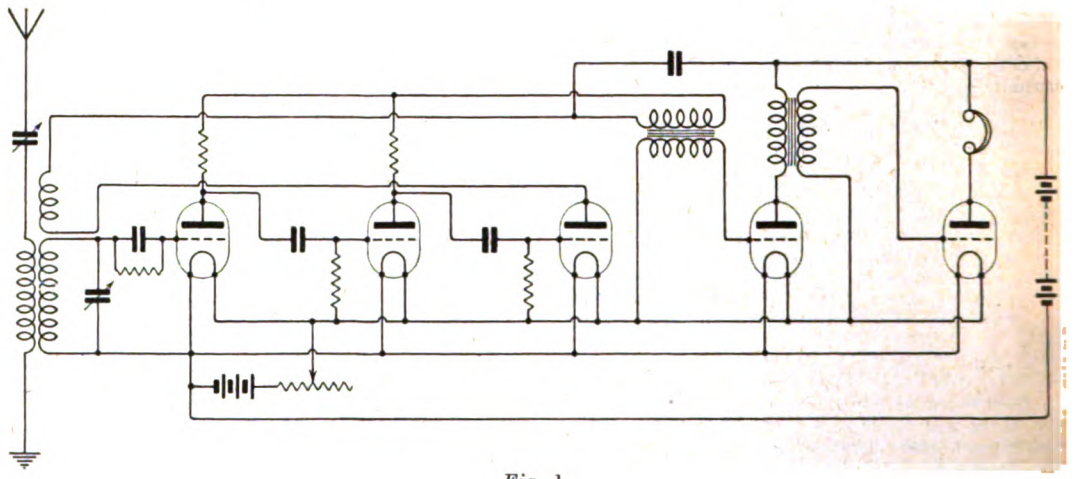

*Fig.* 1.

(1) See diagram Fig. 1. (2) The set is O.K. for the purpose, except that the reaction coil should be in series with the anode resistance and not in shunt across it.

**"J.L.S." (Huddersfield)** *asks* (1) *Which of the following coils, honeycomb, slab or solenoid, are best for various types of reception.* (2) *Dimensions for* 0·0001 *mfd. and* 0·001 *mfd. condensers, using* 0·01 *ebonite.*

(1) We have frequently pointed out that this is largely a matter of wavelength. Cylindrical coils are best, but become impracticable on long waves owing to the size involved. Therefore, at such ranges, the more portable but less efficient honeycomb and slab coils are used. Of these, honeycomb coils are considerably better than slab. (2) For 0·001 mfd. seven foils with an overlap for each of 3 cms.; for 0·001 mfd., 19 foils with an overlap of 10 sq. cms.

**"F.W.P." (Tooting).**—(1) The arrangement is quite good, but we should expect it to tune to higher values of wavelengths than you suggest. (2) We prefer the use of C.1 and C.2 to that of C.3 and C.4, but even with these condensers it will be necessary to use interchangeable or tapped transformers to cover the whole range. (3) Diameter, say 1½″, length up to 4″, windings varying from about 30 turns each up to about 50 turns each. Make the final adjustment experimentally.

**"J.G.G." (Holland Park)** *asks if it is possible to obtain results on a single valve set with a twin aerial* 28 *ft. long on masts raised at* 6 *ft. above a flat metal roof.*

The arrangement will give very poor results unless the height of the masts is increased. If the height is increased to say 15 or 20 ft., results should be quite satisfactory.

**"A.L.D." (Horsforth)** *asks for information with regard to a circuit.* (2) *For data for a tuner.*

(1) Quite satisfactory, except that for short waves A.T.C. should be in series with A.T.I., also that the set would give serious re-radiation. C.1, C.2 and C.4 may be 0·0005 mfd; C.3 may be 0·001 mfd. Grid condenser 0·002 mfd., and leak 2 megohms. (2) Coils used might be as given to **"J.D." (Cambridge)** above.

**"J.L.C." (Finchley)** *submits an arrangement for supplying H.T. for a valve from house mains and asks* (1) *If satisfactory.* (2) *If it is detrimental to an aerial to have it fixed to a tree with overhanging branches.* (3) *If he will be infringing a patent by using home-made apparatus which is patented by a commercial firm.*

(1) This depends on the voltage your valves will stand. The arrangement will give them practically full voltage of mains and will be correct if they will stand it. Otherwise, a number of lamps should be used in series as a potentiometer, and the valve tapped across the desired number to get the right voltage. (2) This will lead to some inefficiency. (3) See reply to **"A.B.C." (Leicester)** in this issue.

**"PETE" (Earl's Court)** *asks how to make a* 0·0015 *mfd. variable condenser as described in the issue of August* 21*st*, 1920, *which is now out of print.* (2) *What resistance telephones are required for the single valve set described in the issue of February* 5*th*, 1921.

(1) The condenser had 30 fixed and 29 moving plates, diameter of moving plates being 2·5/16″, gauge of plates No. 20; spacing washers 2 mms. thick. (2) Anything over 2,000 ohms.

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**"J.D." (Cambridge)** *asks* (1) *For a loose coupler for* 100/1,000 *metres with a* 0·002 *mfd. condenser.* (2) *Diagram for a three-valve panel to fulfil certain conditions.* (3) *If a crystal with separate heterodyne gives as good results as a single valve.* (4) *Approximate range with a* 1½ *kW. telephone transmitter and a three-valve receiver.*

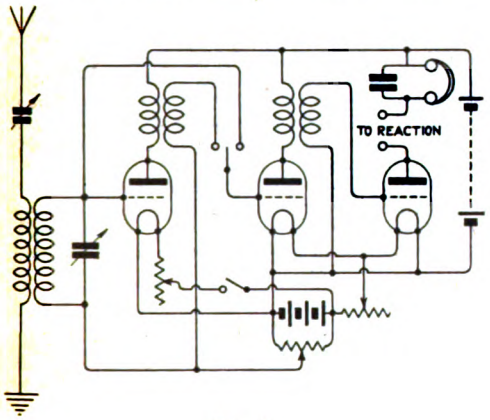


*Fig. 2.*

(1) Primary, 6″ × 4″ of No. 22, with a slider secondary 5″ × 3″ of No. 26, tapped at 1″, 2″ and 3″. (2) See diagram Fig. 2. (3) No. (4) About 100 miles for good results.

**"W.H.M." (Kingston)** *asks* (1) *If a larger aerial makes reception stronger, or if it merely governs the wavelength.* (2) *Asks for a multi-valve set to fulfil certain requirements.* (3) *If increase of his aerial will need the introduction of any instruments to bring the wavelength back to normal value.*

(1) Generally gives increased strength of signals. (2) See Fig. 2, page 276, May 27th issue, and many similar circuits, but we should caution you that the satisfactory construction of such a set is extremely difficult without previous experience with simpler types, as there are numerous pitfalls which can only be found out by experience. (3) The increase of your aerial will not very greatly affect your wavelength except at minimum values. The wavelength can be reduced again by the addition of a series A.T.C. if necessary.

**"MINOR" (Dartford)** *asks for information on the construction of a resistance capacity L.F. amplifier.*

The arrangement should be exactly similar to the H.F. amplifier of this type, except that the intervalve capacity used may be about 0·005 mfd., and the leak less than usual, say 200,000 ohms.

**"TREBLE" (Littleborough)** *asks* (1) *Whether it is possible to receive* 700 *ms. on a set arranged for* 1,500 *ms. and over.* (2) *If the earth wire may be connected to water-pipes going all through the house.* (3) *If various wires in his neighbourhood are likely to give him induction troubles.* (4) *If a frame aerial would give him any better results.*

(1) Not without various alterations to the set. (2) No, provided that the pipes run fairly near to the receiver. (3) The only wires likely to interfere seriously are the tram wires, but these are likely to give you a good deal of trouble. (4) This might help to cut out some of the trouble from the tram wires.

**"D.S." (Ferryhill)** *asks* (1) *Whether certain Brown telephone transformers are suitable for use with low resistance telephones.* (2) *Number of sheets of foil for a certain condenser.* (3) *Wavelength range of his set.* (4) *Whether a power station* 100 *yards away is likely to give him any trouble.*

(1) We cannot say without examination, but probably not, as many of these instruments are merely for use with the Brown telephone relay, with windings quite unsuitable for your purpose. (2) Four. (3) 7,000 ms. max. (4) Probably not seriously, although it is impossible to say for certain without test.

**"R.B." (Oldham)** *asks* (1) *Whether a single valve circuit would give good results on broadcasting at ten miles with a loud speaker.* (2) *For a good book on valve theory.* (3) *Windings for an A.T.I. and reaction coil for* 3,000 *ms.* (4) *Why telephony is receivable on a crystal.*

(1) No, at least one stage of note magnification would be required for good results. (2) Bangay's "Oscillation Valve" is quite a good book at a reasonable figure. Scott-Taggart's book on valves is also a good work on a larger scale. (3) Primary, 9″ × 6″ of No. 22; secondary, 7″ × 5″ of No. 26. (4) Because the audio frequency variations of the carrier C.W. have similar effects on the detector and the telephones as the audio frequency sparks of a spark set.

**"S.W." (Portsmouth)** *asks how to add an amplifying panel to his present single valve panel.* See diagram Fig. 3.

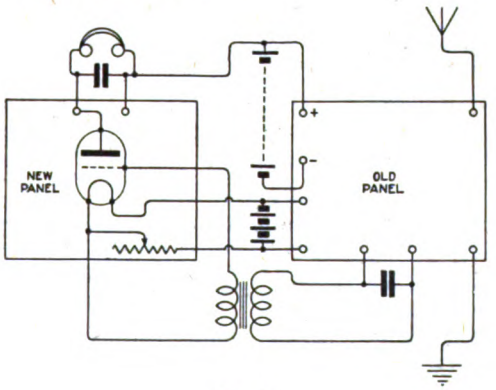


*Fig. 3.*

**"_____" (Folkestone)** *asks* (1) *For wiring for a variometer to tune a circuit from* 400 *to* 1,500 *ms.* (2) *For a reaction coil to suit a circuit up to* 15,000 *ms., and to use with a certain frame.*

(1) The prediction of a variometer to fulfil this requirement would be very difficult, and the instrument would be very inefficient at the shorter wavelengths. It would be much better to use a solenoid coil with taps, and a spherical at one end to provide tuning between the taps. Coil might be 8″ × 4″ of No. 22, with a 3″ spherical at one end. (2) Try 9″ × 8″ × 1½″, wound with No. 26, with tappings at 6, 12, 24 and 30 turns.

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**"A.E.R." (W.1.)** *asks for diagram of a six-valve receiving set embodying five H.F. valves and one rectifier and making use of magnetic reaction.*

For circuit see Fig. 4. It is essential that the transformers should be of precisely the same value as in a multi-valve H.F. amplifier. Should one or two transformers have slightly different values they will filter out wavelengths on which the others are designed to give amplification. With an amplifier of this sort you are advised to adopt a construction for the transformers that will permit of them all being precisely the same. We would recommend you to wind the transformers on a 1" ebonite rod, making primary and secondary each of a single layer and insulated from one another by a single wrapping of empire cloth. Make both windings in the same direction and the finishing ends will go to grids and plates. The rectifying valve should be specially selected to give good rectification, such as "Q," "Qx," or "R4B."

**"C.H.H." (Sheffield)** *asks* (1) *Whether a certain three-valve set can be used with a frame to receive* 2 MT *and other similar stations.* (2) *For the capacity of certain condensers.* (3) *What type of valve to use.* (4) *If the aerial and the set should be in the same room.*

(1) Possible, if not too badly screened. (2) Variable, 0·0005 mfds.; fixed, 0·0002 mfds. (3) Any good hard valve on the market. (4) Yes.

**"THREE VALVE" (Westcliffe)** *asks* (1) *For a three-valve circuit to fulfil certain requirements.* (2) *If H.F. is the best way to add a third valve.* (3) *Why long wave stations have gone weak on his set although it still gives short wave stations all right.* (4) *Why the positive plates of his accumulator have fallen to pieces.*

(1) See diagram for **"J.D." (Cambridge)**, using an L.F. transformer in place of the second H.F. transformer shown. (2) Yes. (3) Impossible to say without some knowledge of the type of

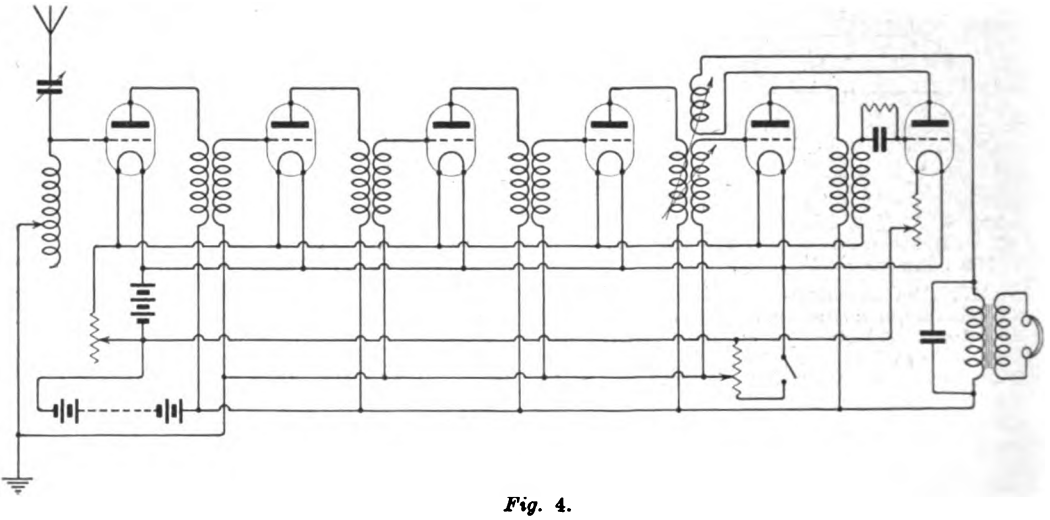

*Fig.* 4.

**"H.L.F." (Kensington).**—(1) Primary, 8"×6" of No. 22; secondary, 6"×4" of No. 26. (2) See Fig. 4, page 372, June 17th issue. The grid condenser may be 0·0002 mfds., and the grid leak 2 megohms. (3) Yes.

**"J.W.B." (Birmingham).**—(1) These coils will tune to about 2,600 ms. on an average P.M.G. aerial. We cannot state the minimum value at all accurately, but it will probably be less than 300 ms. (2) Yes. (3) For PCGG resistance coupling, but for broadcasting transformer coupling will be better. (4) Connect the reaction coil in the anode of the detecting valve. Use the condenser in series with the aerial tuning inductance.

**"R.G." (Newport, Mon.).**—(1) This is probably due to considerable capacity in these coils. (2) This might easily be the case if coils A and B were fairly tightly coupled. A similar effect might be noticed if your aerial circuit were not tuning properly. This is not an unusual freak effect obtained with an untuned aerial. (3) Do not use a microphone; use direct connection from the set.

circuit you are using; but it may be due to a bad connection or a short-circuited turn in some part of your circuit which is not in use on the shorter wavelengths. (4) This is a common result of careless treatment, too rapid charge or discharge, or wrong density of acid.

**"N.S." (Manchester)** *asks where to obtain drawings of the seven-valve amplifier shown on page* 14 *of "The Construction of Amateur Valve Stations."*

This amplifier is the design of a commercial company, who have naturally not authorised the publication of their drawings, although diagrams of the instrument have appeared in various places, as for instance in Fleming's book of valves. The instrument is a commercial amplifier designed for special purposes, and is useless as a receiver without the addition of suitable tuning circuits.

**"W.G." (Hastings).**—(1) Circuit shown is quite correct. Wavelength maximum probably about 3,500. (2) See Fig. 5, page 124. (3) The telephones may be used without change. (4) Circuit should be efficient at all wavelengths.

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**"C.H.S." (Wolverhampton)** *asks* (1) *If it is probable that the use of reaction will not be allowed in the case of broadcast receiving apparatus.* (2) *If there is a circuit which gives the advantages of reaction without the risk of reradiation.* (3) *For circuit diagram of a two-valve broadcast receiver.* (4) *For the errors to be pointed out in certain calculations he has made from data with regard to inductance and wavelength.*

(1) and (2) We cannot say, but we should imagine that no steps would be taken to prohibit the use of such an excellent property as reaction in receiving circuits, though every effort should be made to prevent the use of circuits in which the reaction coil is coupled back directly to aerial inductance. Reradiation is reduced by adopting intervalve H.F. coupling and arranging the reaction between grid and plate circuits of the second valve. See circuit Fig. 5. (3) See circuit Fig. 3, page 436,

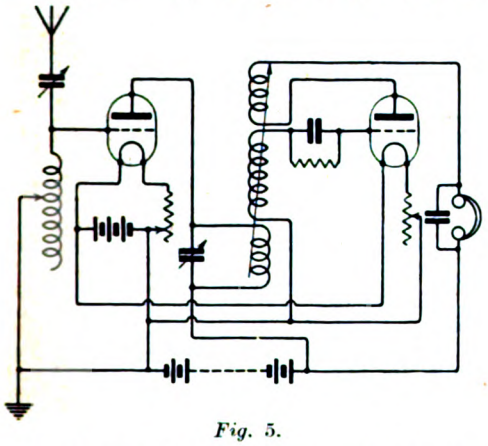

*Fig. 5.*

or Fig. 5, page 437, July 1st issue, omitting reaction coil in each case. (4) Without going deeply into your figures we would point out that any calculations of this nature are perfectly useless with regard to the determination of the values of loading inductances for use in amateur circuits. For instance, without calibrated apparatus it is not easy to determine the capacity or inductance of an aerial, but is comparatively simple to conduct a few experiments to find the amount of wire necessary to load to a given wavelength.

**"S.J.N." (Tottenham)** *asks* (1) *For criticism of an enclosed diagram.* (2) *Maximum wavelength of the set.* (3) *Maximum capacities of variable condensers.*

(1) The circuit shown is O.K. but the coil marked reactance is only a closed circuit inductance and not a reaction coil. A reaction coil might be added in the plate circuit of the valve, coupling with the above coil, which should, moreover, be wound with about No. 28 or 30. The values will then be O.K. (2) Approximately 3,599 metres. (3) 0·0005 mfds.

**"SPARKS" (Morecambe)** *asks* (1) *If a circuit enclosed is correct and suitable for telephony.* (2) *If the earth lead to a water-pipe 10 ft. away is O.K.* (3) *For a diagram for adding another valve to his set.*

(1) O.K., except that for short waves the A.T.C. should be in series with the A.T.I. (2) O.K. (3) See Fig. 1, page 119, issue for April 22nd.

**"UNCLE TOM" (Bournemouth)** *asks* (1) *For a diagram of a two-valve transmitter for C.W. and telephony.* (2) *Data for wiring transmitter.* (3) *If more valves can be added without dismantling set.* (4) *Values of condensers and resistances.*

(1) See diagram (Fig. 00). (2) It depends largely on the aerial. Try about 40 turns on a former 3" diameter for the A.T.I., and 80 turns on a 2" diameter former for the reaction. (3) Not usefully, except in parallel with the oscillating valve. (4) For grid condenser 0·001 mfds, with 250,000 ohms. Feed condenser try 0·0005 mfd.

**"N.S." (Pendleton)** *asks* (1) *Why transmitting stations give call signals in Morse and not speech.* (2) *For an opinion on B.T.H. portable set.* (3) *How to adjust his three-valve set.*

(1) Telephonic stations usually give calls in speech. Telegraphic stations call in Morse, as they are generally incapable of speech. Some telegraphic stations experimenting in telephony call in Morse as this is their normal method of communication. (2) This set is quite O.K. for getting various high power stations and ships under favourable conditions, but is not intended for short-wave telephony on which the range is poor, unless specially wound for the purpose. (3) Impossible to say without knowing the type of set to be employed.

**"BEGINNER" (Leyton)** *asks* (1) *If an amateur can construct an efficient portable set.* (2) *Where he can obtain details of construction of same.* (3) *In which issue can he get detailed instructions of a three-valve set.* (4) *Would this set be efficient on a frame aerial.*

(1) Yes, but we should not advise a beginner to work on a set of this type. (2) We do not know of any suitable detailed instructions. (3) and (4) A suitable set for this purpose is described in numbers 16 to 21, Vol. VIII, which can be obtained from the publishers.

**"T.J.W." (Much Wenlock)** *asks* (1) *The simplest way to add a valve to a certain crystal set.* (2) *What telephony he would hear if a valve were added.* (3) *Why he gets nothing with his crystal set although he gets clicks when joining up the telephones.* (4) *If a broadcasting station is likely to be established near.*

(1) The only easy way would be the addition of a note magnifier, as in Fig. 2, page 336, but a new set on the lines of Fig. 5, page 124, would give much better results. (2) You should get stations as in question 4, with the altered set. There is probably very little to be got at present. (3) The set and aerial are of somewhat poor quality. You are not likely to get strong signals on a crystal in your district. (4) Birmingham and Manchester will be the nearest stations, neither of which you are likely to get very strongly on a crystal set.

**"READER" (Norwich)** *asks* (1) *What is the maximum distance from which his set would receive telegraphy.* (2) *How much wire would wind a certain former full of No. 26.* (3) *Would his circuit be satisfactory using the inductance sketched.* (4) *What wavelength could he reach with a certain set which he describes.*

(1) You should get FL, Nauen, and a few similar high power Continental stations. (2) 700ft., say ¾ lbs. (3) O.K. (4) 4,500 metres.

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**"DEAF" (Wolverhampton)** *asks* (1) *If there is any likelihood of the Post Office refusing to allow amateurs to use valve sets.* (2) *Will it be possible to receive broadcasting successfully on a crystal set and to use a loud speaker at about* 30 *miles distant.* (3) *The best crystal set which does not require a battery.* (4) *Can crystals be purchased which never need adjustment.*

(1) No, although sets capable of reradiation may be forbidden. (2) 30 miles can be done under favourable conditions on a crystal set, but it will not operate a loud speaker, which would necessitate the use of a two or three stage L.F. amplifier. (3) Zincite-copper pyrites is very good, but, like all other sensitive combinations, does require some adjustment. (4) Carborundum seldom needs adjustment, except a slight variation of potentiometer setting from time to time.

**"PARALLELEPIPED" (Bournemouth)** *asks* (1) *Could he receive at Bournemouth* FL *time signals and weather forecast with an aerial frame* 4′ *square and crystal detector.* (2) *How many turns of wire in the aerial would give the best results with* 2,600 *metre waves.* (3) *Would tram wires* 80′ *distant cause trouble.* (4) *What is the carborundum detector described on page* 359 *which requires no adjustable potentiometer.*

(1) No. (2) About 20. (3) Not unless you are using several stages of amplification. (4) The crystal used is of normal type. The absence of need for a potentiometer is due to the special circuit employed, of which we are not at present at liberty to give further particulars.

**"S.O.S." (Oundle).**—(1) Impossible to say on the little information you give. Either there is something seriously wrong with the connections or the coils are of unsuitable dimensions. (2) Yes, if condenser is used across the telephones, but the set will give serious reradiation trouble.

**"G.E.B." (Manchester).**—(1) This could be done but would not be very efficient. (2) Wind 40 turns on a frame 3′ in diameter, tapping at 5, 10 and 20. (3) Connect a condenser across this frame and a condenser across the filament and grid of the valve. (4) About 45 plates would be required.

**"J.H.B." (Muswell Hill)** *asks for criticism of a set.*

The circuit is fairly good, but a condenser is required across the telephones, also the use of coupled circuits would minimise reradiation; and we do not advise gas-pipe earths.

**"M.C.N." (Yarnton)** *wishes to make up receiving set to the diagram given on page* 368, *June* 17*th issue, and asks* (1) *Whether certain makes of inter-valve transformers would be suitable.* (2) *Whether any alteration is necessary.* (3) *The resistance ratios of the transformers marked* 1/1 *and* 10/1. (4) *Where he can obtain suitable variable condenser.*

(1) We should prefer you to use transformers of the type marked "B." It is essential that these inter-valve transformers be wound in such a way that their values can be relied upon to be identical. Should one transformer operate on a slightly different band of wavelengths to the others, it will filter out signals which the remainder of the transformers would efficiently amplify. (2) No alterations are necessary excepting that a much smaller aerial tuning condenser will be required, as you only intend to tune up to about 3,000 metres. (3) 9,000 to 1,700 ohms and not 1/1 as shown. 11,000 to 120 ohms for low resistance telephone receivers. (4) Use an aerial tuning condenser with air dielectric and a maximum of 0·0015 mfd.

**"W.E.C." (Putney)** *asks* (1) *If circuit diagram Fig.* 33 *on page* 340, *June* 10*th issue is suitable for use with "Oojah" slab coils and five intervalve H.F. transformers for ranges of* 300 *to* 5,000 *metres.* (2) *Or alternatively, for a three-valve diagram embodying one H.F., one rectifier and L.F. magnifier.*

(1) Yes, these coils and transformers may be used as components for building up the circuit for wavelengths beyond 1,500 metres. You may find it easier to adopt resistance capacity valve coupling as shown in Fig. 2, page 294, June 3rd issue. (2) For suitable circuit see Fig. 1, page 58, or Fig. 1, page 37, in April 8th issue.

**"R.W.S." (Highbury)** *wishes to know how he can use a Marconi crystal receiver set, Type* 16, *in conjunction with a three-valve amplifier and loud speaker.*

You would be well advised to dismantle the crystal receiver and re-wire the components, making use of the potentiometer for controlling the grid of the first valve. The aerial circuit may stand as it is for tuning, and the closed circuit, together with its "Billi" condenser may be arranged to give reaction effects. Suitable circuit to use as a guide in effecting these changes will be found on page 304, June 3rd issue. You do not describe the three-valve amplifier, but if it is of the low frequency type you may fit the reaction coil in the plate circuit of the first valve, bridging the primary of the first transformer with a condenser 0·002 mfd.

**"J.A.R." (Walsall)** *wishes to install a receiver suitable for reception of broadcasted telephony, and asks* (1) *For circuit diagram and dimensions of coils, condensers, etc.* (2) *For details of high-tension transformer, if it is needed for use with his receiving set.*

(1) It is regretted that we cannot give you sufficiently complete details to be of help to you in setting up your receiving station. We would suggest that you read carefully the articles that we are publishing in alternate issues under the heading of "Experimental Station Design," the first of which appeared on May 27th last. The first instalment relates to the construction of aerials, and subsequent ones deal with the design of apparatus, and as you intend to construct your own outfit, it is probable that these articles will reach an advanced stage, giving you all the information required before you have had time to complete your outfit. (2) A high-tension transformer is not required for use in receiving apparatus, and no doubt you mean an inter-valve transformer, a description of which will shortly be given in the articles referred to.

**"J.G.C." (Ealing)** *refers to the article on an "American Short Wave Receiver," in the June* 3*rd issue, and asks the meaning of "Regenerative."*

The word "Regenerative" has usually the same meaning as reaction, and in the tuner referred to both grid and plate circuits are tuned by means of variometers, these adjustments facilitating the setting up of oscillations. The coupling back of the plate circuit to the grid circuit is effected by the relative dispositions of the various coils shown from Fig. 2, on page 283.

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**"H.R.W." (Mildenhall)** *gives a cross sectional drawing of a former for constructing intervalve transformers, the diameter of which is 1", and asks for windings to cover wavelengths on 300 to 3,000 metres.*

For 300 to 500 use 450 turns for primary and the same number for the secondary; for 500 to 1,000 use 1,200 turns for each, and for 1,000 to 3,000, 5,000 turns. We recommend you not to make use of tappings, but to make separate transformers. As you propose to use a variable condenser with the transformer it is better to put the two windings on separately with insulation between. Put the windings on in opposite directions, taking the finishing end of the primary to plate and the beginning end and secondary to grid, the secondary winding being wound on over the primary.

**"HEAD WEIR" (North Devon)** *submits a circuit of a five-valve amplifier which makes use of break-jacks for varying the number of valves and circuit, and asks* (1) *For diagram showing the external connections and* (2) *For the number and dimensions of plates for the construction of the various condensers shown.*

(1) The aerial inductance is connected in series or parallel with aerial tuning condenser according to whether reception on short or long wavelength is required. The grid of the first valve and the common L.T. minus are connected across the ends of the aerial inductance. The reaction coil which is coupled to the aerial inductance, is plugged into the jack, which is connected in series with the plate circuit of the third valve. (2) The grid condenser should consist of three plates, being wound one in one direction, and two in the other, separated from each other by mica 0·002" in thickness, and having an overlap of 1" by $\frac{5}{8}$". The condenser which shunts the primary of the first low frequency inter-valve transformer, should consist of 15 plates, being 7 in one direction and 6 in the other, and having an overlap of 1" by $\frac{5}{8}$". Condensers are not required across the second and final L.F. transformers. The condenser which bridges the high-tension battery may have a value between 0·05 and 0·25 mfds., and can be made of tin foil with wax paper separation, and might roughly consist of 20 plates with an overlap of 4" × 6".

**"F.H." (Long Eaton)** *is constructing the American tuner described on pages 281 to 284, June 3rd issue and asks* (1) *The capacity of the grid condenser.* (2) *What wavelength 416 turns of No. 22 wire on a round former 6¼" in diameter would give.* (3) *Whether the set is suitable for the reception of C.W.* (4) *Whether any additional apparatus is required.*

(1) A maximum value of 0·0005 mfd. (2) This depends upon the dimensions of your aerial, but with double cotton-covered wire the maximum wavelength would be about 3,800 metres on a two-wire aerial of the dimensions specified by the P.M.G. (3) Yes, but a little coupling between the grid and plate inductances is assumed owing to the manner in which they are arranged in the set. (4) No other apparatus is required to complete the single-valve receiver, and it can be thoroughly recommended for use exactly as shown in the diagram without the addition of other variable condensers.

**"M.A." (Nottingham)** *asks for windings of H.F. aperiodic transformers, using "Eureka" wire, and suitable for wavelengths between 300 and 1,000 metres.*

Wind with No. 47 S.S.C. "Eureka" wire on a 1" ebonite rod former, using 600 turns for primary, and 600 for secondary, separated from each other by a single layer of empire cloth, and both wound in the same direction. The leads which terminate at one end of the former are taken to grid and plate. 300 to 1,000 metres is rather a broad band for one transformer to operate on, and you will get better results if you provide a tapping at 200 turns on each winding for use on wavelengths of less than 400 metres.

**"E.H.N." (Colchester)** *sends specimens of variable condenser plates and asks* (1) *The number required to build up condensers of 0·0003, 0·0005 and 0·0015 mfds. capacity.* (2) *If he will be infringing patents by constructing and offering for sale, single, two-slide, and loose coupled tuning coils.*

(1) You do not say the spacing you propose to adopt between the plates, but if you make it one-eighth of an inch between consecutive fixed or consecutive moveable ones, you will require 7 fixed and 6 moveable for 0·0003 mfds., that is, 13 plates; 21 for 0·0005 mfds., and 61 for 0·0015 mfds. (2) We regret that we cannot constitute ourselves as advisers on questions relating to the use of patents.

**"A.C.D." (Leeds)** *possesses tuning coil and loose coupler, and asks for a three-valve circuit making use of this, and giving particulars of the other components required to build up a three-valve circuit.*

If you have fair experience in the manipulation of wireless apparatus you might adopt circuit tuning Fig. 1, July 1st issue. This circuit is described more fully on page 37, April 8th issue, where the values of the various condensers are shown. If you are a beginner we would advise you to follow the articles which are appearing fortnightly in this journal on Experimental Station Design. You will easily be able to embody your tuner in the making of the sets described.

**"H.B." (Birmingham)** *states that he is constructing an aerial tuning inductance 8" long by 6" in diameter, and proposes winding with No. 24 D.C.C., and asks for the positions for tapping off to give wavelengths 250 3,000, stepping up by ranges of approximately 100 metres in the lower values and 500 metres in the higher ones.*

It is impossible to say to what wavelength your inductance will tune as the range entirely depends upon the capacity and inductance of the aerial to which it is connected. Using a parallel condenser of maximum capacity 0·0015, your inductance will probably tune to a maximum wavelength of 3,500 metres on a two-wire aerial of the maximum dimensions specified by the P.M.G. If connected to a single-wire aerial the coil will probably only tune to 2,500 metres. We regret we cannot give tappings for the wavelengths you ask, but would recommend you not to bother about particular wavelengths, but to tap off at increasing intervals along the coil, bearing in mind that the wavelengths are proportional to the square of inductance, which is approximately directly proportional to the number of turns.

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**"P.V." (Manchester)** *refers to a diagram of the Marconi seven-valve H.F. amplifier and asks* (1) *How to couple it to a tuner, making use of interchangeable coils.* (2) *Sizes of former, and wire for winding H.F. transformers suitable for reception of telephony.* (3) *The values of the condensers that bridge the primary and secondary windings of the transformers and* (4) *The method for connecting potentiometer to the rectifier valve.*

(1) Connect the aerial tuning inductance across the grid and potentiometer terminals of the first valve; *i.e.*, the two terminals shown on the extreme right. Reaction may be arranged in a variety of ways, but as the amplifier is only operative on a narrow band of wavelengths, perhaps the best way is to wind an inductance that can be coupled with the aerial coil, and connecting it to the terminals "G" and "F," leaving terminal "F" connected across to the next terminal on the right. Alternatively a small coil may be wound, say of 20 turns of No. 34 S.S.C. wire on a 1" former, and connected in series with the aerial inductance. This coil should be placed near the end of the third or fourth intervalve transformer. (2) The winding of the transformer is very important, and must be very carefully carried out. One faulty transformer will filter out wavelengths on which the others operate best. For wavelengths of 250-420 metres, wind the transformers with 260 turns of No. 38 S.C.C. on a 1" ebonite rod. Primaries and secondaries should have exactly the same number of turns, and be separated from one another by a single layer of empire cloth. The two windings should be in the same direction, and the leads which come from one end of the transformer are taken to grid and plate. (3) The six condensers bridging the transformer windings should be of the order of 0·0005 mfd. The condenser bridging the L.F. transformer to have a capacity of 0·001 mfd., that across the potentiometer 0·0003, and the one from the telephone transformer secondary to the L.T. minus, about 0·05 mfd. (4) Separate grid control for the rectifier valve can be arranged by connecting potentiometer across the L.T. battery, and taking the lead that would normally go to "G," after, if necessary, passing through the reaction coil to the sliding compact.

**"T.H." (Highbury)** *asks whether we would recommend the use of circuit Fig.* 6 *in "Construction of Amateur Valve Stations," for use with a frame aerial.*

This circuit cannot be recommended with a small indoor frame aerial. The circuit is not provided with reaction, a property which is practically essential for frame aerial reception. You do not say the maximum dimensions of the frame, but we would recommend you to adopt four feet to six feet at the minimum, and use a circuit built up on the lines of Fig. 7 in the book to which you refer.

**"V.G." (Luton)** *has a Mark III crystal receiver, 2,000 ohm telephone receivers, and an aerial 25 ft. high by 75 ft. long, and wishes to know if the outfit is suitable for reception at Luton of telephony from Marconi House and Writtle.*

You should be able to get the telephony from Marconi House, though perhaps with difficulty. It is doubtful if the telephony transmission from Writtle can be received on a crystal set at this distance. When a system of broadcasting on higher power than is used at present is established your set should prove quite useful.

**"C.W.G." (Hull)** *draws our attention to the diagrams given in connection with the article on single valve long range receiver which appeared in Volume* 8, *and points out a discrepancy in the practical wiring diagram and the circuit diagram.* (2) *If a diagram he submits is the correct way for rearranging the reaction coil.*

(1) You should wire exactly as in Fig. 1, on page 781. The construction in this set necessitates fair skill in pile winding, which if not carefully executed will nullify any merits there may be in the special design of the receiver. You would be well advised to follow the details given under the heading of Experimental Station Design, particularly that appearing in July 8th and subsequent issues. (2) The diagram you give for tapping out the reaction coil is quite correct and you should take care that the single layer winding for short wave, which is on the outside, continues in the same direction as the pile winding. The spindle connection is taken from the finishing end of the outer single layer, the short wave tap is taken from the connection between the outer layer and the pile winding, and the long wave tap from the beginning end of the pile winding.

**"L.F.S." (Edgbaston)** *submits a circuit comprising H.F. amplifier, detector, and note magnifier, and asks* (1) *For criticism.* (2) *For the completion of a skeleton three-valve diagram.*

(1) The condenser marked "A" has a capacity of 0·001 across the primary of the H.F. transformer, and, we presume, is variable. You should endeavour to operate this transformer without a variable condenser, and if that does not give good results, the maximum capacity condenser that may be used efficiently is 0·0004 mfd. The remainder of your circuit is quite correct and should give good results. It is advisable in such a circuit to use special valves designed to function efficiently in the various circuits in which they are connected. The H.F. and note magnifier valves should be of the "R" type. The detector valve should have good rectifying properties, such as "R4B" or "QX." As you use a potentiometer to control the grid potential of the rectifier, a soft valve, or one having a steep curve, would give good results. (2) We have scrutinised your diagram, and it is quite correct.

## SHARE MARKET REPORT

Prices as we go to press on July 17th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 3 | 6 |
| ,, Preference .. .. | 2 | 1 | 0 |
| ,, Inter. Marine .. .. | 1 | 7 | 6 |
| ,, Canadian .. .. | | 11 | 0 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 14 | 0 |

The Report of the Directors of the Marconi International Marine Communication Company Ltd., and Statement of Accounts for the Year ended 31st December, 1921, was presented to the shareholders on Tuesday, July 25th, 1922.

The Directors recommended the payment of a final dividend at the rate of 5 per cent., which together with the interim dividend declared at the beginning of December last, amounts to 10 per cent. for the year.

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THE
WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
VOL. X. No. 19. AUGUST 5TH, 1922 WEEKLY

# Radio House

## LONDON'S MAIN WIRELESS TELEGRAPH OFFICE.

IN the following article it is proposed to give some account of what may be termed the nerve centre of the commercial high speed wireless telegraph services of the Marconi Company.

Radio House, situated at the corner of Wilson Street and Eldon Street, in the city, is the building from which all these services are now controlled, and traffic with the United States, Canada, France, Spain and Switzerland, and the extension of the American service to South America, the West Indies, and Australasia, all passes through the instruments located here. At Radio House every effort has been made to meet the special requirements of speed and accuracy, and the whole organisation for dealing with the traffic is as up-to-date as possible.

From the counter in the public office runs a conveyer to a circulation table equipped with numerous time-saving devices, and the different transmitting and receiving circuits are located round this table in the main operating room. Each circuit has its own special table, and Fig. 1 shows the table allotted to the service with Paris, the call-sign of the wireless station at Paris being UFP. This table is typical of the others. At these tables, which are standard in design, messages are first reproduced in Morse characters on a perforated paper tape, by means of keyboard perforators seen on the extreme right of the table. These keyboard perforators are operated in the same way as a typewriter. The paper tape is then fed into automatic high speed transmitters, which in the case of the French and Swiss circuits, actually operate the wireless transmitting stations located at Ongar, in Essex.

Alongside the transmitting instruments are the receiving circuits from the respective countries, so that it is possible for the operator who is transmitting to be checked or interrupted at any moment by the receiving station at the other end. It is of interest to consider in detail the handling of traffic on these tables, and as an example we will take the case of the Paris circuit shown in Fig. 1, and trace the operation of the instruments shown.

The messages to be transmitted are taken in turn from the rack shown on the right of the table, and are punched up on the paper tape by means of the keyboard perforator. Fig. 2, which illustrates the table of the Berne circuit, shows an operator engaged on this work. As messages are punched in Morse symbols on this paper tape, the tape is fed through a Wheatstone transmitter, this instrument serving to reproduce the dots and dashes in the punched tape as electrical impulses of correct duration, on the line which goes to the wireless transmitting station and controls its operation.

For those who are not familiar with the Wheatstone transmitter, it may be mentioned that it is practically a special form of Morse key, which is mechanically driven, and capable of high speed operation, and is controlled by means of the punched paper tape instead of by hand. At Radio House the Wheatstone transmitters are driven by special electric motors having a wide range of speed, and can be set to run exceedingly steadily at any particular speed required.

Alongside the Wheatstone transmitter is placed an ordinary hand-operated key, which can be used when the volume of traffic does not justify the use of high-speed working.

The galvanometer shown near the key is for

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the purpose of balancing the line against the artificial line in duplex working.

As is well known, a simplex telegraph circuit is an arrangement of a key, battery and sounder at each station, so that either one or the other station can transmit.

In duplex working, both stations can transmit and receive at once, and repetitions, etc., can be asked whenever required.

There are two main systems of duplex working, known as the "bridge" and the "differential" methods. The differential system is employed at Radio House. On the left of the key, and sunk in a glass-covered well in the table, are located the instruments, comprising the artificial line, together with two relays—one a differential relay (which is the distinctive feature of the differential duplex system), and the other a transmitting relay, which is controlled either by Wheatstone or hand-operated key, and passes out the signalling current to the line.

So far, reference has only been made to the apparatus connected with the transmitting side. On the left of the artificial line are the instruments which record the received wireless signals from the distant station, which, in the case of Fig. 1, is Paris. The wireless receiving station for Paris is located at Brentwood, and from thence to Radio House the received wireless signals are conveyed by land line. The receiving apparatus at Brentwood is very much of the usual type used at a C.W. receiving station, but instead of receiving the signals in telephone headgear in the ordinary way, these signals have to be sent over the land line to Radio House and there operate inductive, pulsating currents which are relays. Since the average relay is highly suited to telephonic reception are not suitable for actuating relays. It is therefore necessary to smooth out these pulsating currents in order that they may be able to control a relay, and this relay in turn conveys the Morse signals

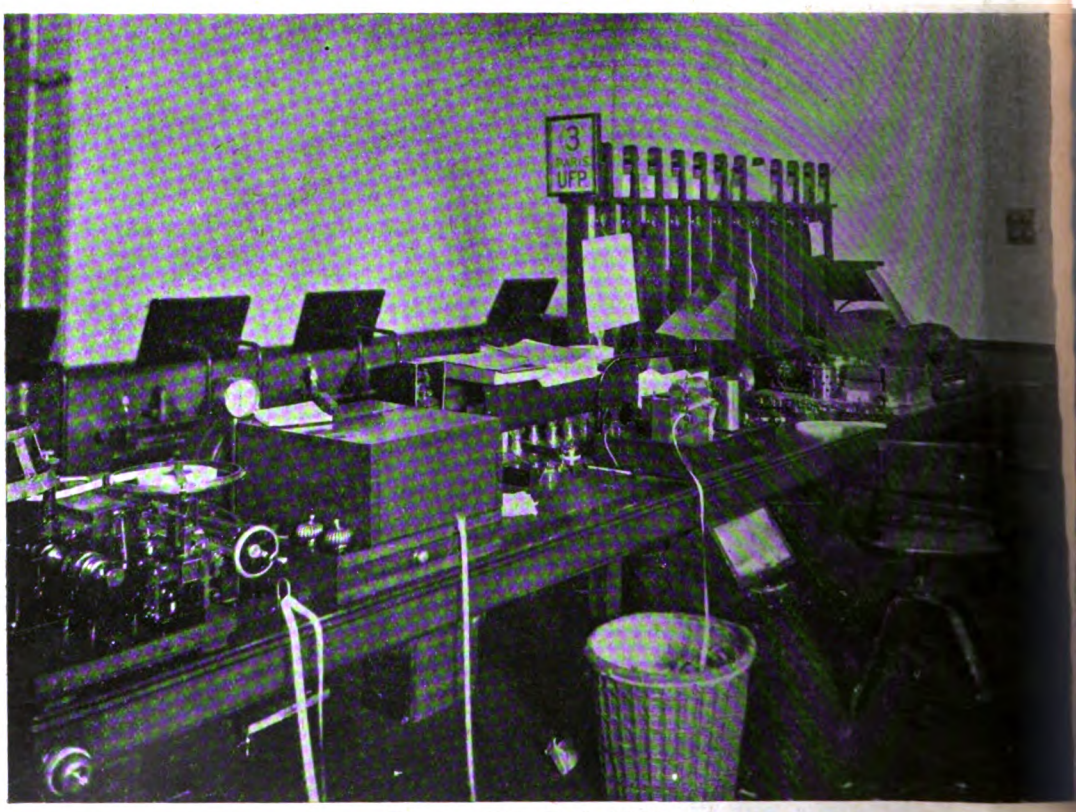


*Fig. 1. The Paris Table.*

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into the land line connecting Brentwood with Radio House. In the case of reception by head telephones, it is of course necessary that the currents should be pulsating, in order that they may actuate the telephone diaphragms.

Returning again to the standard table of the Paris circuit at Radio House, shown in Fig. 1, the signals from Brentwood are fed to the coils of the differential relay referred to above, and this in turn controls a local circuit consisting of either a sounder or an undulator or Creed

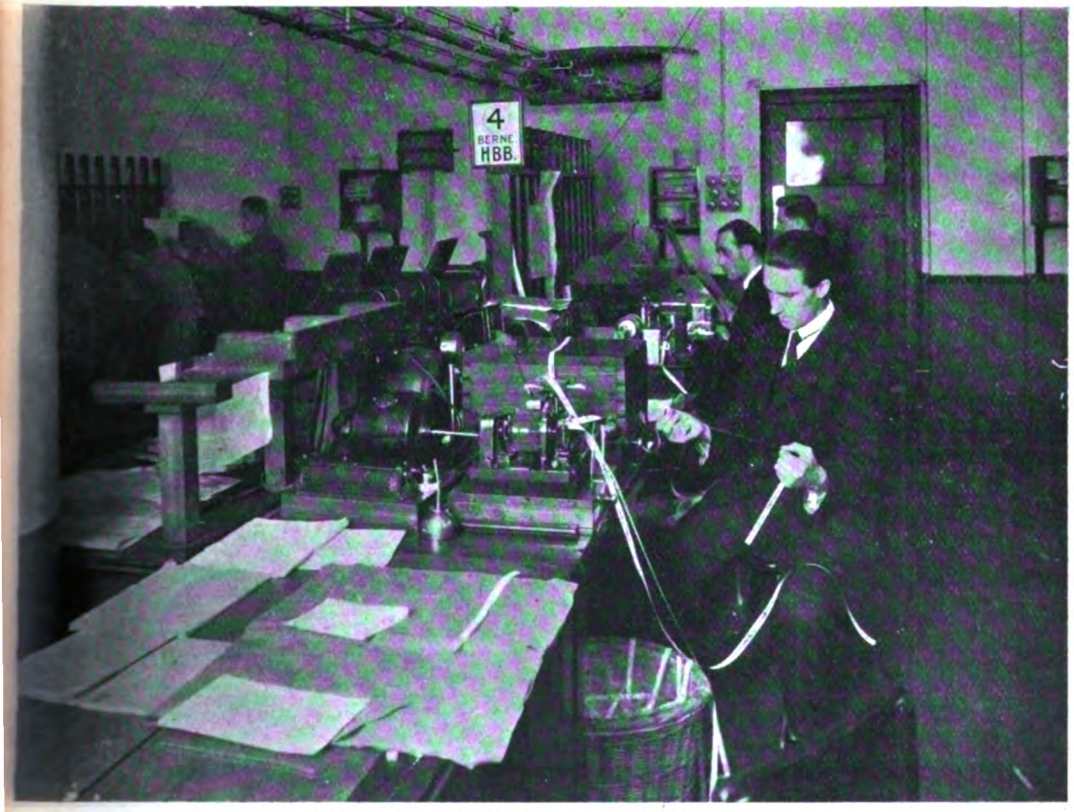


*Fig. 2. Traffic handling at the Berne Table.*

apparatus. The Morse sounder is not capable of working at speeds of the order of 80 to 110 words a minute, and the undulator is therefore used for high speed reception, the sounder only being used in conjunction with the hand-operated key when there is a small volume of traffic, or for the purpose of breaking in during transmission. The apparatus is actually a type of syphon recorder. It is driven by a small motor, and feeds paper tape past a silver or glass syphon. The syphon is controlled in the usual manner by means of a sensitive electro-magnet. Whilst spacing current flows through the coils of the electro-magnet, a continuous straight line is drawn by the syphon on the tape, but when marking current is flowing, the syphon is deflected across the tape, and remains there until the spacing current returns. The result is that a reproduction is made of the dots and dashes sent into the line by the relay, the relay being controlled direct by the wireless signals received at Brentwood.

With the undulator it is possible to receive at very high speeds, and it may be mentioned that messages are frequently transmitted and received duplex at speeds of about 110 words a minute for hours on end. Messages received in this way are recorded in Morse symbols on the paper tape, which next passes to operators who are working typewriters, each fitted with a special rest to hold the message form in a convenient position for typing. The operator

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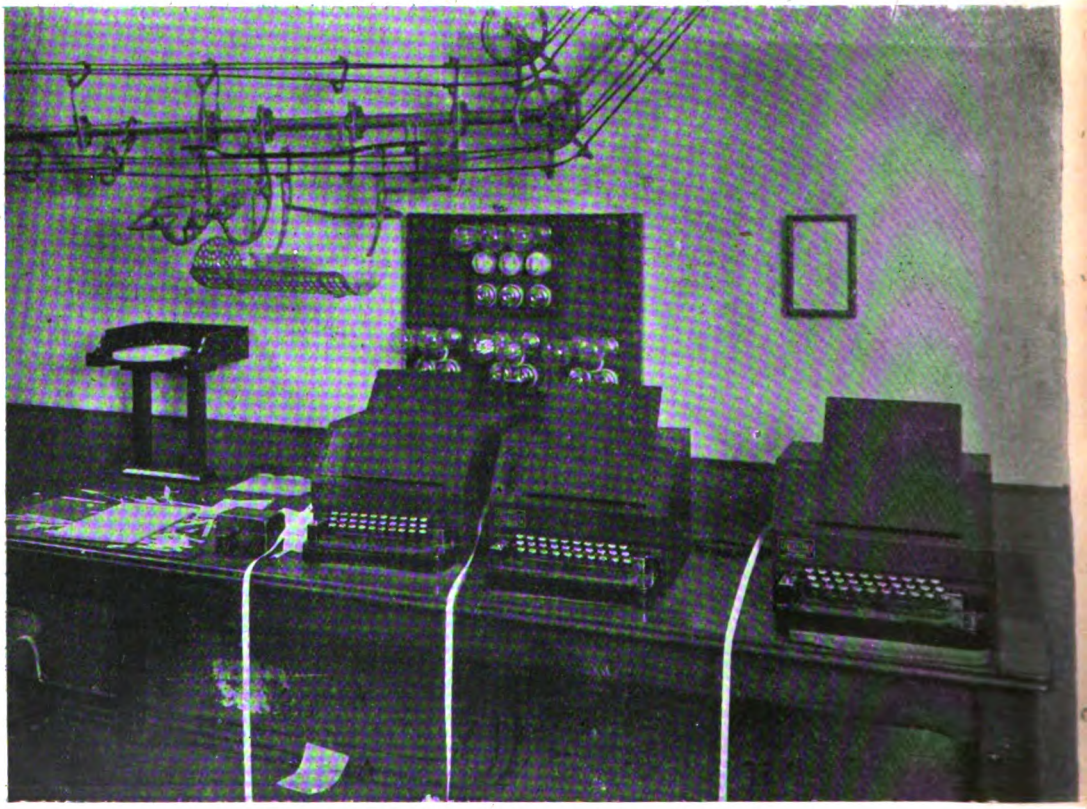
translates the Morse slip and types out the message in Roman capitals on another form, which is the actual message handed to the addressee.

So far we have referred only to the undulator and sounder methods of reception, but these are not the most important, since the principal method for dealing with traffic is now by means of the Creed receiver and Creed printer. A description of this apparatus has already appeared in this journal, on pages 475 to 480 of the issue of October 29th, 1921.

offers a variety of methods for sending and receiving. The particular method to be used is decided by the operator, who is guided in his decision by the volume of traffic to be handled at the time, and also by the wireless conditions. In cases of rush of traffic, and under good wireless conditions, the Wheatstone transmitter would be used at high speed for transmitting, and the Creed receiver for receiving, duplex working being conducted.

In the event of any interruption owing to a



*Fig*, 3. *Teletype Machines and Lamson Carriers.*

By means of this apparatus, the received signals are made to punch paper tape in exactly the same way as the keyboard perforator already referred to. This tape is then fed through the Creed printer, which automatically translates the punched Morse signals on the tape into Roman capitals, and types out the message on a paper strip in Roman capitals. This paper strip is gummed on the message form for delivery to the public.

It will be seen, therefore, that the table

fault in any of the instruments, one of the other methods can be used till the fault is rectified.

In addition to these methods, it is also possible to receive by means of telephone headgear in the ordinary way, provision being made on the table for plugging in telephone leads when required. and the receiving station at Brentwood would then be requested to send through the signals in the form of pulsating currents, instead of smoothed-out currents,

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to which reference has been made in the case of operating a relay.

It may be of interest to trace the course of a message from the time it is handed in over the counter until its arrival in the rack on the right-hand side of the table shown in Fig. 1. Messages handed over the counter at one of the Marconi branch telegraph offices are sent to Radio House by teletype which, being a special form of printing telegraph at the receiving end of the telegraph line, prints the message which has been typed out on a typewriter keyboard at the transmitting end. Fig. 3 shows some of these instruments. All messages arriving at Radio House go direct to a distribution table, whence they are distributed to their correct pigeon-holes on the respective tables. Lamson conveyers (shown in Fig. 3) are used extensively in Radio House for conveying messages from one place to another.

In addition to the principal tables, which deal with foreign circuits, there are a number of lines for conducting the traffic of many business houses.

Beneath the instrument room there is a special repair shop for the purpose of effecting repairs to any of the apparatus in use.

# Experimental Station Design

*Continued from p. 511, July 22nd, 1922.*

*These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they may be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## IX. AN AIR DIELECTRIC VARIABLE CONDENSER.

IT is intended that this condenser shall be constructed without the use of a lathe, and to permit of this certain departures from the usual practice have been made, such as the omission of metal bushes for bearings for the main spindle and collars on the spindle which can only be obtained by turning. The end plates (Fig. 1) are made first from ⅜ in. polished ebonite sheet. These are made to size by careful filing and the edges are finished as described in previous articles under this heading, and must be at right angles to each other and at right angles to the faces. The dimensions given are based upon the use of condenser plates of the sizes shown in Fig. 2. There are many varieties of condenser plates on the market, which, though very similar in outline, vary slightly as to radius and location of holes. If the reader is unable to obtain plates similar to these

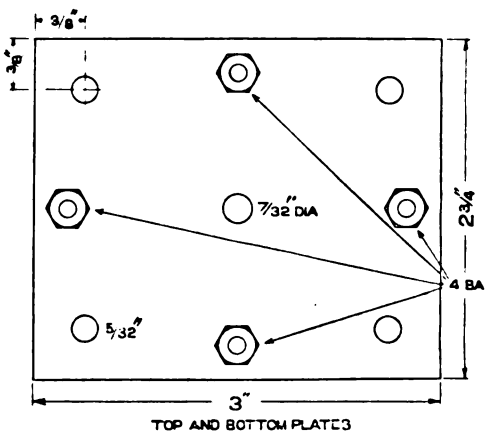


*Fig. 1. Ebonite end plates, Thickness ⅜". Three of the nuts are on the rods carrying the plates and the other holds the steadying rod.*

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shown he will need to make slight modifications in the dimensions of the end plates, which will present no great difficulty. One of the fixed plates may be used as a template for making the holes in the correct positions. A plate can be clamped to the face of one of the end pieces in the vice and two of the holes drilled through, taking care not to force the holes in the soft plate aside as the drill passes through into the ebonite. Placing the shanks of similar size drills or well fitting brass rods through these two holes, the plate will be held in position for drilling the third. A hole is also made to carry a steadying rod,

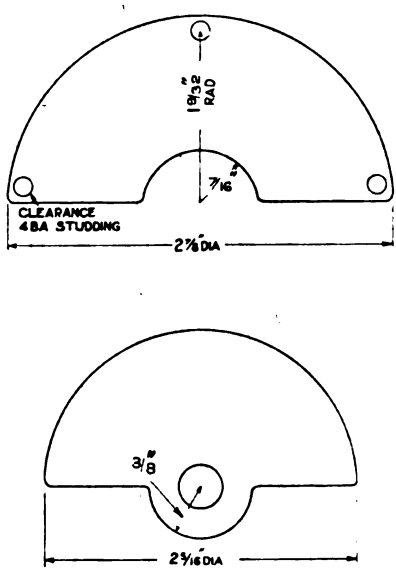


*Fig. 2. Condenser Plates of the pattern usually obtainable. Thickness is No. 20 S.W.G.*

and the position for this is found by placing a plate with its two corner holes over the two side holes just made, but with the third hole in the plate on the opposite side. The third hole now indicates the position for making the hole for the steadying rod. Holes are also made through the four corners at ⅜ in. from each edge to provide for fixing the condenser to the panel or other apparatus in which it is mounted. The two end pieces may be drilled through together, one over the other, but if this is done great care must be taken that the drill passes in exactly at right angles to the face. Especially does this apply to the centre hole, which forms the bearing for the spindle.

The dimensional drawing of the spindle (Fig. 3) can only be worked to provided the spacing washers are 3/32 in. thick and the plates of 20 S.W.G. If washers and plates of these dimensions are not available a simple calculation must be made to determine the length of spindle that is required between the two screw-threads. There is no reason of course, why the number of plates shown in the drawing should be adhered to, as no exact capacity is aimed at. For simplicity one might easily adopt the dimensions given, putting on as many plates as space permits. The spindle is made from hard brass rod of a size exactly fitting the hole in the movable plates, which is usually 5/16 in. After being cut to length, the ends are filed clean and by means of a centre-punch, holes are punched in the ends to indicate the exact centres. The spindle can be then spun between pin-points to observe whether there is any wobble indicating whether or not it is perfectly true. Alternatively, it can be tested by rolling on a flat surface. Truing up can be done by hammering with a wooden mallet should it be necessary. Absolute trueness is essential, and will save a great deal of trouble when assembling. The filing of the ends to a smaller diameter must be very carefully carried out in order that they may be concentric with the main portion. Opposite sides are filed down to nearly the required diameter, and the new edges which are now presented should appear exactly parallel to each other. Two other flat faces are next made at right angles to those just made. This will leave four corners, or four rounded corners, according to the amount of reduction in the diameter required. These corners are filed away until the width between opposite corners is the same as between the two opposite faces first made. The rod is by this process reduced to octagonal section and all edges must run precisely parallel. Measuring for distance between opposite faces can be accomplished by means of callipers or if not available, a slot can be made in a piece of brass sheet of the exact width and used as a gauge. The eight corners which the rod now presents must be removed by filing until the width of the face thus made is equal to the width of the remaining portion of face. The rod now presents 16 edges, and these are removed by revolving the rod on the side of the bench whilst the file moves across it. It will soon become quite round, and must be tested for fit from time to time

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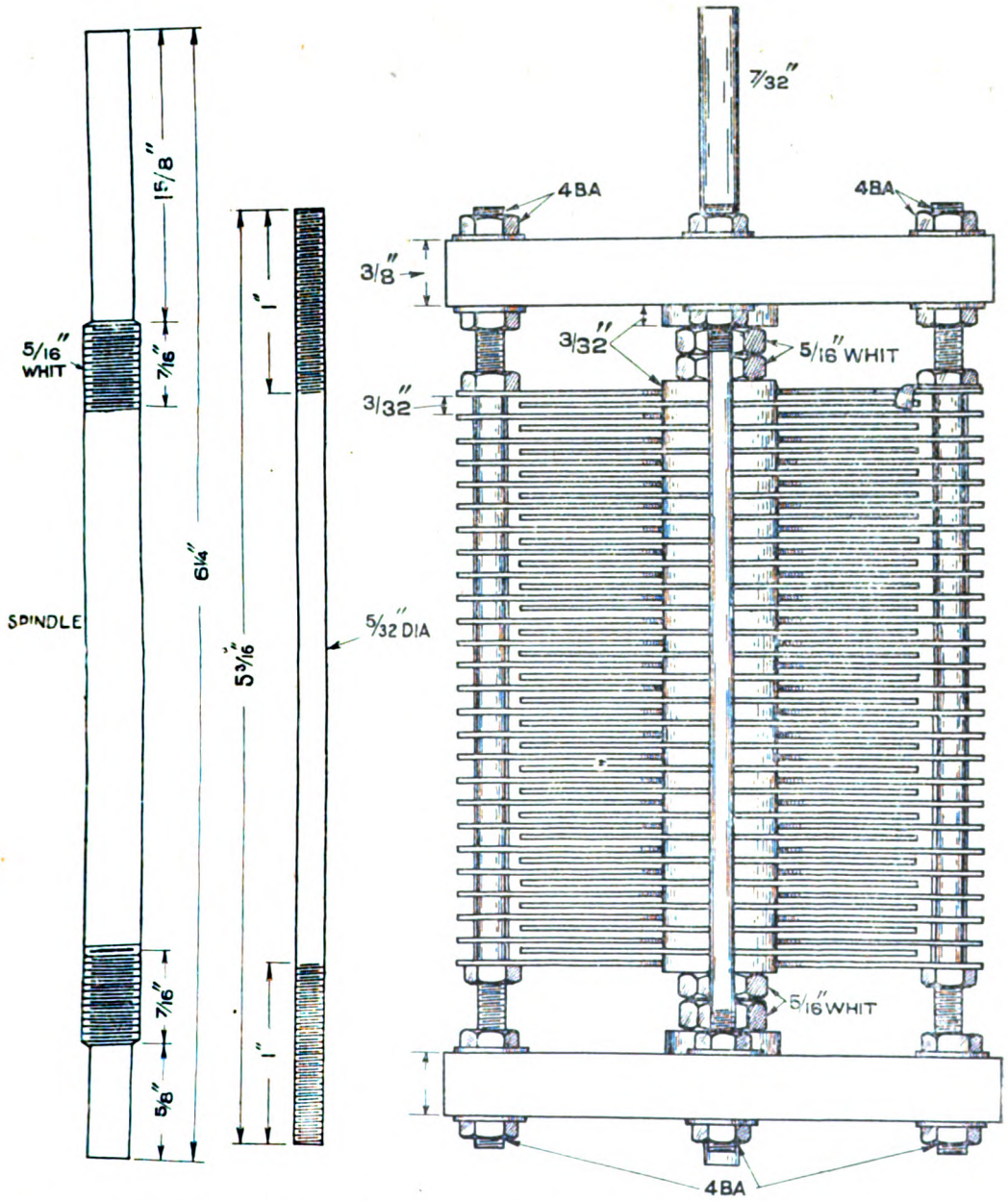


*Fig. 3. Method of assembling the Condenser. The arrangement of the end pieces permits of critical adjustment and correct setting for movable plates and a condenser made to these dimensions and with the plates very carefully and evenly spaced has a capacity of about ·0012 mfds.*



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in the holes made in the ebonite. It should be filed down until it is a very tight fit, and then by the use of emery cloth the scratches can be removed and the fit of the spindle in its ebonite bearings made a little easier. The two ends are treated in this manner to the distances shown in the drawing. The cutting of the threads is effected by the use of a die of the required size. The spindle is held vertically in the vice, the jaws of which should be faced with zinc or lead to prevent damage to the spindle. It should not project out of the vice more than is necessary, to eliminate the danger of bending. The die securely fixed in its holder is forced down on the shoulder produced by the reduction in diameter of the end of the spindle, and rotated in a clockwise direction. It is as well to turn the die back through a distance of half a revolution after every one or two complete revolutions in order to break off the chips that may get wedged in the die. If the reader has never attempted the cutting of small screw threads previously he should experiment on a piece of scrap rod. It is not necessary to make a shoulder for practical purposes, but the removal of the abrupt edge at the end of the rod will assist the starting of the die. The job could easily be carried out by the ironmonger if necessary, and a light file mark might be made on the spindle to indicate to him the distance to which the thread must be carried.

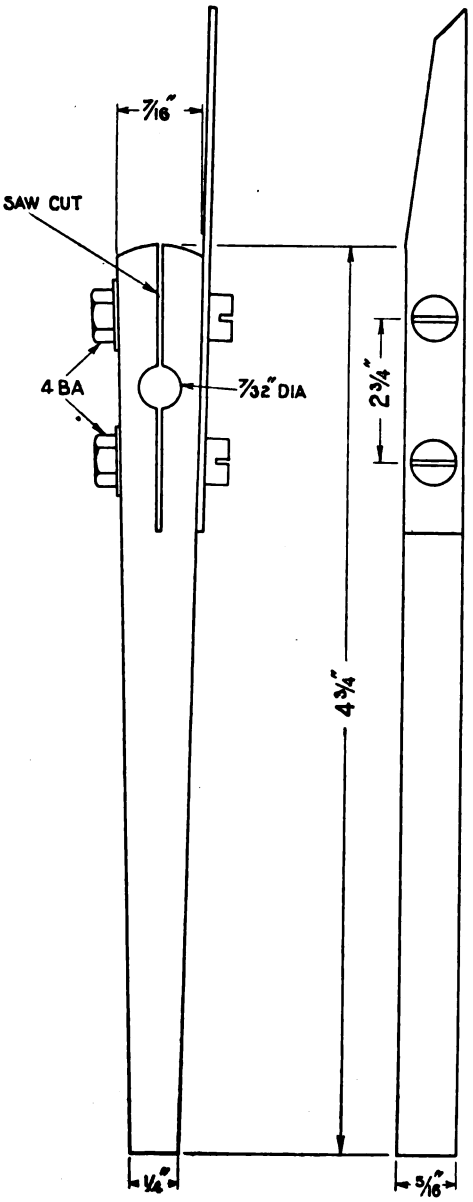


*Fig. 4. Handle and Pointer.*

On completing the spindle, the next step is to assemble the moving plates upon it. Two hexagon brass nuts are locked together at one end, followed by a spacing washer of about $\frac{5}{8}$ in. in diameter, or as may be supplied with the particular style of plates purchased. A plate is then placed on the spacing washer and followed by other plates and washers alternately until the plain portion of the spindle is completely covered, when the plates are pressed together tightly. A spacing washer, followed by two lock-nuts screwed home tightly, will hold the plates securely in position after they have been arranged in alignment. Two other washers are then placed over the ends beyond the nuts, and the distance at which the ebonite end pieces are to be mounted will be indicated.

When this is done the supporting rods for the ebonite pieces and fixed plates can be cut to length from brass rod of such a size as will just pass through the holes in the fixed plates. These holes are usually of a size that will just pass rod which is suitable for taking a 4BA thread, but unfortunately, as the size of the hole is not standardised, the reader may require to use larger rods, such as may need a 3BA thread. The construction of the rods is quite apparent from the drawings, and little explanation is required, four rods being necessary, one of which is merely for the purpose of steadying. Before proceeding to assemble the fixed plates the

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ebonite end pieces should be rubbed down with fine emery paper, as described in an earlier article, and given a good matt finish. The fixed plates can now be assembled on the rods and tightly locked home by means of end nuts. The moving plates are then dropped into position, and the ebonite pieces pushed on. The other nuts carried by the rods supporting the fixed plates serve for critically adjusting the ebonite pieces, so that there is no play on the spindle, and also facilitate the correct setting of the fixed plates relative to the moving ones. Should the reader require to provide a stop to prevent the moving plates from rotating through more than 180 degrees, this can be done by inserting under one of the nuts which clamp down the fixed plates, a small piece of brass sheet bent round to engage on the end moving plate. This serves also as a short circuiting contact to connect across the fixed and moving plates, and so throw the condenser out of action after it has reached the position of maximum value. For the purpose of making contact with the spindle, a small curl of wire is soldered to its projecting bottom end and carried across to the supporting rod which does not pass through the fixed plates.

The condenser is now complete except for a manipulating handle, which may be constructed from a strip of 5/16 in. ebonite sheet to the design shown in Fig. 4, which is a sufficient guide to its construction without further explanation, excepting perhaps that it might be mentioned that the hole which is to carry the spindle should be made prior to the saw-cut. This type of handle is to be recommended on account of the fact that the hand of the operator is kept well away from the spindle while adjusting the condenser.

In fitting the condenser to an instrument panel a clearance hole must be made for the spindle, say of $\frac{3}{8}$ in. diameter for a 7/32 in. spindle, as it is not intended that the panel to which the condenser is mounted should serve as a further bearing. Attachment is arranged by passing four brass screws through holes in the panel which coincide with the corner holes in the ebonite end pieces. Nuts are run up on these screws tight against the back face of the panel, and with the aid of four other pairs of nuts the condenser is spaced a little way from the panel to allow for the nuts projecting from the ebonite end plate of the condenser.

F. H. H.

# An Amateur Station at Harringay

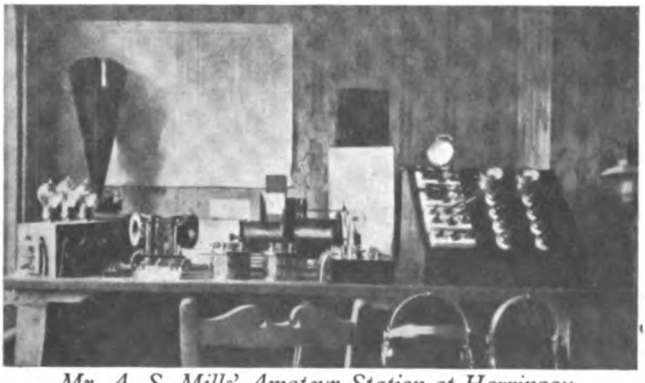
By A. S. MILLS.

THE accompanying photograph is of my five-valve set. This set tunes from 200 to 25,000 metres—from 200 to 2,000 by means of a loose coupler (I find this still best for the shorter wavelengths) and from 2,000 upwards I use honeycomb coils. The loose coupler can be seen in the centre of the photograph with the coils on the left. The switches in the front of the coil holder are for changing over from the loose coupler to the coils.

On the extreme left is a three-valve L.F. amplifier, and behind this a loud speaker mounted on a single-valve amplifier. Actually this is in a room below the set so that the family may get the benefit of the concerts. It is, however, soon to be replaced by a Brown H.1.

The switch-board on the right contains the H.T. and L.T. batteries and voltmeters, series parallel switch for A.T.C., switch for cutting out the amplifier and aerial earthing switch. All connections are made beneath the table, and altogether the set has a very neat appearance.

Results are very good on spark, C.W. and telephony. Many amateurs can be heard at quite a distance from the phones, whilst Marconi House can be heard using no aerial whatever.



*Mr. A. S. Mills' Amateur Station at Harringay.*



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# Remote Control by Radio.

## A NEW RELAY RECORDER.

By F. W. DUNMORE.

*The following abstract of a paper read before the American Institute of Electrical Engineers on April 19th, 1922, describes the development and method of operation of a new type of relay recorder which operates directly from the output terminals of a wireless receiver. Two types of relay are described, which are classified as Type A and Type B. Type A is designed to be operated by batteries, whilst Type B is operated from 60 cycle 110 volt lighting circuits.*

*A valuable and distinctive feature of the relay is that it is tunable to different frequencies and can be made to respond only to signals of one particular frequency.*

TYPE A.—FOR USE WITH BATTERIES.

1. *Object of Development.* The object of this investigation was to develop a relay which should operate by received radio signals.

2. *Requirements.* To be satisfactory as a relay recorder the device should have the following characteristics: (1) it must be of simple construction with few adjustments; (2) it must be easy to adjust and capable of being put into operation quickly; (3) it must be selective and as free from static and such disturbances as possible; (4) it must be capable of operating at a speed of at least 12 times per second; (5) it must respond to weak signals; (6) it must be of strong design, durable, and capable of maintaining its adjustments; (7) it must be portable.

3. *Circuit Used.* In order to avoid the use of a very sensitive relay designed to operate on currents of a milliampere or less, with delicate adjustments and light contacts and spring tension, advantage was taken of the radio-audio amplifier (which has now become a reliable radio instrument) to increase the input voltage to the relay circuit, thus making possible the use of a simple ordinary high-resistance telegraph relay. The relay device has therefore been developed to operate from the output circuit of any suitable amplifier in place of the ordinary telephone receivers.

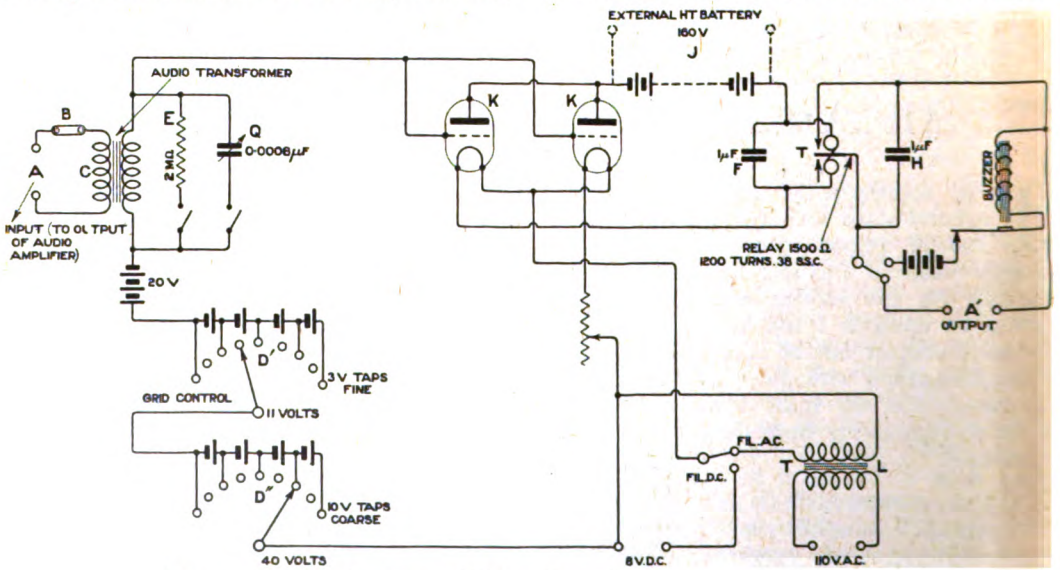


*Fig. 4. Circuit diagram of Relay Recorder for use with Batteries.*

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The only adjustment necessary is that of an ordinary telegraph relay.

Fig. 1 shows the wiring diagram. *A* is a telephone plug for connecting the relay device to the amplifier output. *B* are phone terminals so that if desired the operator may listen to the received signal in the ordinary way. *C* is an audio transformer of the type used in audio amplifiers. *E* is a two-meghom, grid leak. *Q* is a 0.0006-microfarad variable condenser

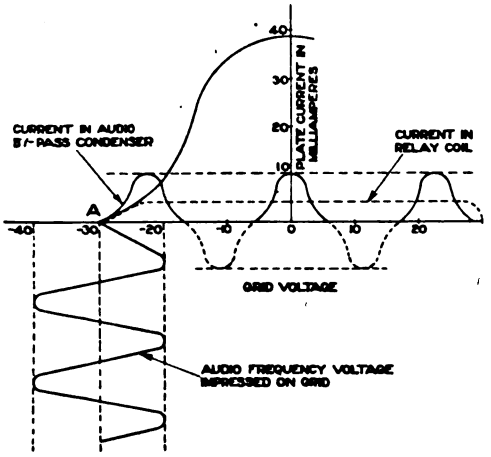


*Fig. 2. Tube Characteristic showing principle of operation of Relay Recorder.*

or 0.0003-microfarad fixed condenser. *D* is a 60-volt variable grid battery, variable in steps of approximately three volts. *J* is a 160-volt dry H.T. battery, self-contained within the set. *K* is a type *UV*-201 Radiotron. *F* and *H* are each a one-microfarad paper condenser. *T* is an ordinary telegraph relay rewound with 1,200 turns of number 38 S.S.C. enamel wire. *A'* is the output to be connected to the apparatus to be controlled. *L* is a step-down transformer for operating the tube filaments from the 110-volt A.C. supply when such a supply is available.

4. *Principle of Operation.* The principle of operation is illustrated in Fig. 2. By means of the variable filament battery *D*, the grid voltage is adjusted to approximately 30 volts, at which value the plate current is zero, as shown at *A*. The incoming audio-frequency voltage impressed on the grid varies the grid potential, for example, from — 30 to — 20 volts. The 10 volts decrease from — 30 to — 20 causes an increase, for example, from 0 to 10 milliamperes, while the increase from — 30 to — 40 volts, is not effective in causing a plate current to flow, due to the fact that — 30 volts is already sufficient to reduce the plate current to zero. The result will be a pulsating direct current of 10 milliamperes, maximum amplitude, in the plate circuit. This current, flowing through the plate circuit and condenser *F*, (Fig. 1), causes an increase in the plate current at the keying frequency, which change, passing through the relay coil, will pull the relay armature over, making contact at *T*, which contact may control any mechanism desired. With the grid battery voltage adjusted for maximum sensitivity it was found that static induction, etc., operated the relay. When these disturbances are not as strong as the signal, their effect on the relay may be overcome as shown in Fig. 3. For example, the grid battery is shown increased to — 35 volts, the critical value for maximum sensitivity being — 30 volts. The disturbances due to stray currents, etc., merely reduce the grid battery voltage to — 30, which is not sufficient to cause plate current to flow. However, the signal, being of greater intensity than the stray currents, reduces the voltage to — 25, which causes a plate current of five milliamperes.

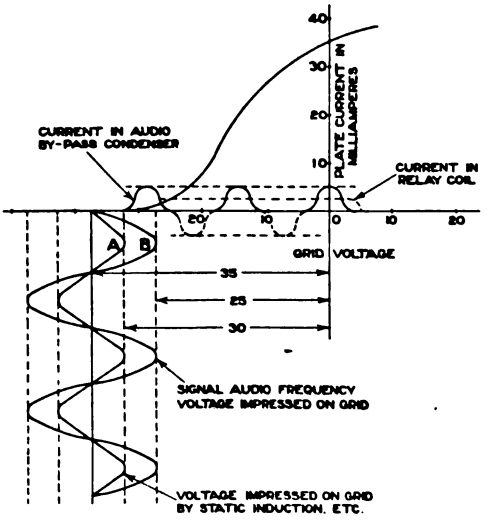


*Fig. 3. Method of eliminating static and induction noises which are not stronger than the signals.*

It will be seen, therefore, that all disturbing effects, if of less intensity than the signal, do not affect the relay.

5. *Method of Increasing Sensitivity and Selectivity.* During the development of this

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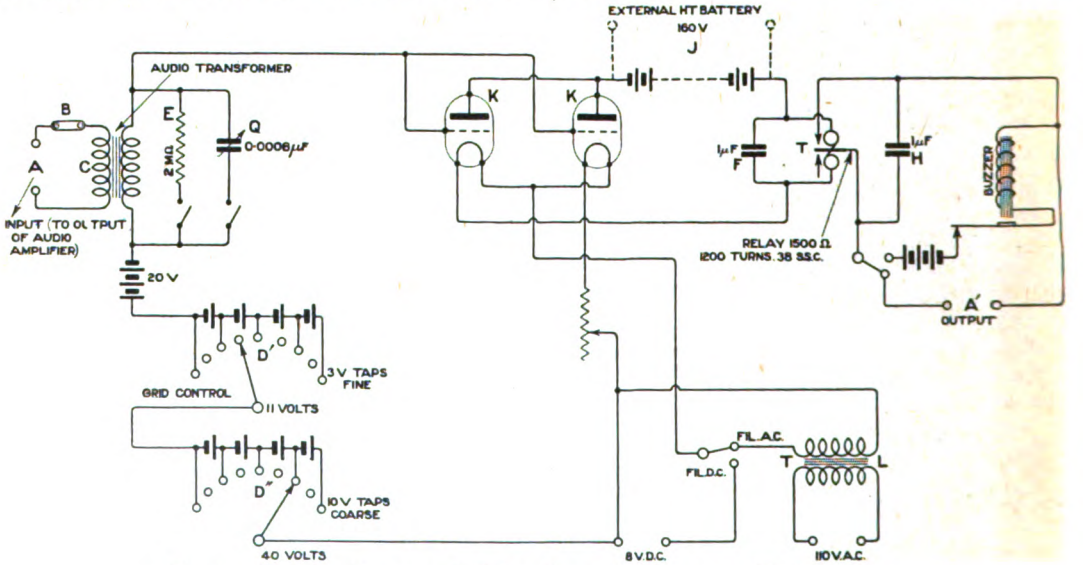


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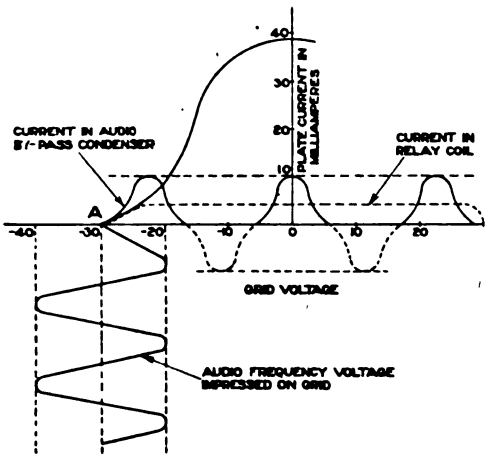


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or 0.0003-microfarad fixed condenser. *D* is a 60-volt variable grid battery, variable in steps of approximately three volts. *J* is a 160-volt dry H.T. battery, self-contained within the set. *K* is a type *UV*-201 Radiotron. *F* and *H* are each a one-microfarad paper condenser. *T* is an ordinary telegraph relay rewound with 1,200 turns of number 38 S.S.C. enamel wire. *A'* is the output to be connected to the apparatus to be controlled. *L* is a step-down transformer for operating the tube filaments from the 110-volt A.C. supply when such a supply is available.

4. *Principle of Operation.* The principle of operation is illustrated in Fig. 2. By means of the variable filament battery *D*, the grid voltage is adjusted to approximately 30 volts, at which value the plate current is zero, as shown at *A*. The incoming audio-frequency voltage impressed on the grid varies the grid potential, for example, from — 30 to — 20 volts. The 10 volts decrease from — 30 to — 20 causes an increase, for example, from 0 to 10 milliamperes, while the increase from — 30 to — 40 volts, is not effective in causing a plate current to flow, due to the fact that — 30 volts is already sufficient to reduce the plate current to zero. The result will be a pulsating direct current of 10 milliamperes, maximum amplitude, in the plate circuit. This current, flowing through the plate circuit and condenser *F*, (Fig. 1), causes an increase in the plate current at the keying frequency, which change, passing through the relay coil, will pull the relay armature over, making contact at *T*, which contact may control any mechanism desired. With the grid battery voltage adjusted for maximum sensitivity it was found that static induction, etc., operated the relay. When these disturbances are not as strong as the signal, their effect on the relay may be overcome as shown in Fig. 3. For example, the grid battery is shown increased to — 35 volts, the critical value for maximum sensitivity being — 30 volts. The disturbances due to stray currents, etc., merely reduce the grid battery voltage to — 30, which is not sufficient to cause plate current to flow. However, the signal, being of greater intensity than the stray currents, reduces the voltage to — 25, which causes a plate current of five milliamperes.

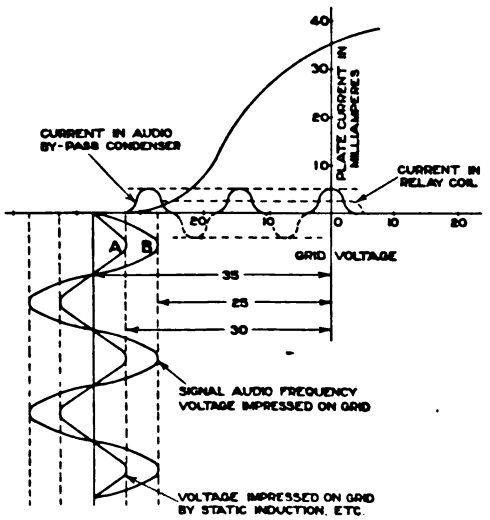


*Fig. 3. Method of eliminating static and induction noises which are not stronger than the signals.*

It will be seen, therefore, that all disturbing effects, if of less intensity than the signal, do not affect the relay.

5. *Method of Increasing Sensitivity and Selectivity.* During the development of this

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relay it was found that the rectified audio-frequency current in the plate circuit caused the relay armature to chatter rapidly and make a poor contact with the fixed contact point through which the circuit is closed. This was overcome completely, however, by the addition of a one-microfarad condenser across the relay coils. This served the purpose of an audio-frequency by-path for the highly inductive winding of the relay, thus greatly decreasing the resistance of the circuit. The change of plate current due to this audio-frequency caused a second change, which occurred at the keying frequency. This latter change passes readily through the relay coils and exerts a strong steady pull on the relay armature without the least chattering.

It was also found that the 0·0006-microfarad variable condenser (Fig. 1) across the secondary of the input audio transformer made possible

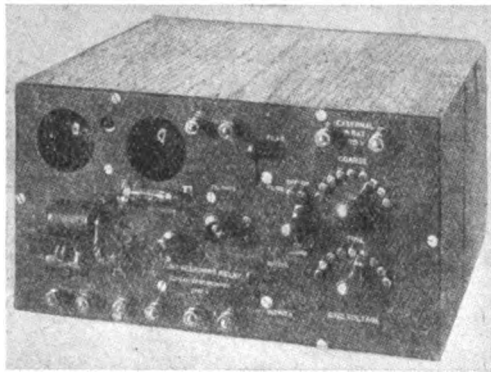

*Fig. 4. Type A Relay Recorder for use with Batteries.*

audio tuning, which increased the selectivity considerably. This tuning was very sharp, and it was found that the European stations could be made to operate the relay while a high-power station here in the United States would fail to operate it, although the high-power station was coming in on the same wavelength and slightly stronger. This was made possible by adjusting the heterodyne note of the European station to a frequency different from that of the local station and then tuning the secondary of the audio transformer to that frequency. The 0·0006-microfarad variable condenser may be replaced by a 0·0003-microfarad fixed condenser and the audio tuning accomplished by adjusting the heterodyne note to the resonant frequency. By means of this audio tuning one of three stations transmitting simultaneously has been selected and caused to operate the relay although all were of equal intensity.

By the use of two relay recorders connected in series across the output terminals of a single radio receiving set, two messages, sent on practically the same wavelength, but of different audio frequencies, have been accurately received simultaneously.

6. *Speed of Operation.* Tests showed that with a signal strength sufficient to produce a plate current of 10 milliamperes the relay could be operated at a speed of 48 contacts per second, the contact being sufficient to operate a buzzer. With three milliamperes in the plate circuit a speed of 27 contacts per second was obtained. With one milliampere a speed of 19 per second. In each case the relay armature spring tension was adjusted for the best operation.

7. *Sensitivity.* As stated above, this relay was designed primarily with the intention of obtaining a device which should be durable, simple in operation, and strong in construction. Sensitivity is obtained by means of radio-audio amplification, thereby increasing the voltage input to the relay circuit and eliminating the necessity of extreme sensitivity in the relay. Tests at 600 cycles showed that the relay circuit was fairly sensitive, as approximately 1·3 volts at the input terminals of the audio transformer in the relay circuit caused a current of five milliamperes to flow through the relay coil in the plate circuit.

8. *Durability.* As the relay instrument used in this recorder is of the ordinary telegraph type its durability is well established. The only elements requiring occasional renewal are the two electron tubes, the 60-volt grid battery, and the 160-volt H.T. battery.

9. *Portability.* The complete recorder, with the exception of the filament lighting battery, is contained in a cabinet 7 ins. by 13 ins. by 11 ins., as shown in Fig. 4.

10. *Uses.*—(1) As an ordinary receiver it has advantages over reception with telephone receivers, for one may receive by buzzer or sounder with all induction and interfering noises eliminated (if not louder than the signal).

(2) A tape or drum-type recorder may be used and a copy made without a trained radio operator.

(3) Time signals may be recorded.

(4) A call system may be worked by a time switch connected to close the filament circuit for a given time at set calling intervals.

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(5) Any form of mechanism may be operated by an incoming signal.

(6) A receiving station may be located remotely from the transmitting station and the radio signals relayed by wire to the operating room some miles distant.

In conclusion it may be stated that a relay of this type should operate satisfactorily, *without attention*, on an airplane where mechanical vibration may be excessive, as the pull on the armature with three milliamperes, or over, in the relay coil makes possible the use of a spring tension on the relay armature sufficient to keep it from moving due to mechanical vibration of the relay.

It would seem that the above-mentioned feature makes this remote control relay more serviceable than those now on the market, which require delicate adjustment of spring tension, contact points, and suspended vibrating elements.

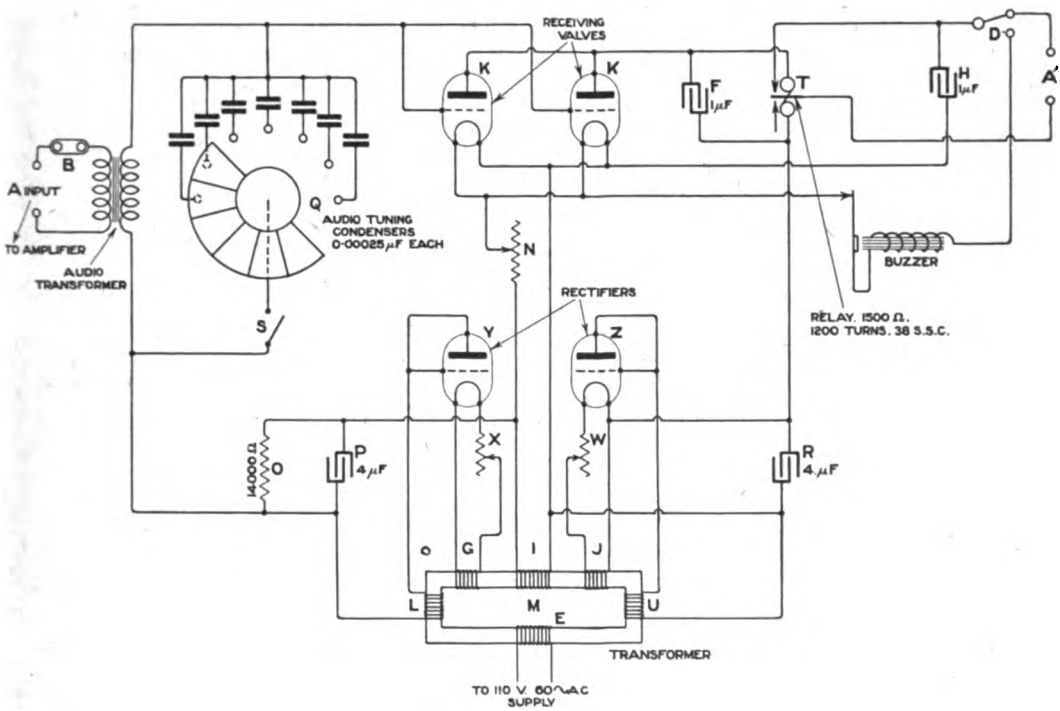


*Fig. 5. Circuit diagram of Relay Recorder for use on the 110-Volt A.C. Supply.*

TYPE B.—FOR USE ON THE 60-CYCLE, 110-VOLT A.C. SUPPLY.

This recorder is similar in construction and operation to the Type *A* recorder, except that the plate and grid voltages are supplied from the 60-cycle, 110-volt A.C. supply. The current for operating the tube filaments is also obtained from this source, so that the recorder is operated entirely independently of any form of batteries. It is only necessary, therefore, to connect to the 110-volt A.C. line and the recorder is ready to operate.

The method of operating the recorder from the A.C. supply consists in the use of the two receiving tubes as rectifiers, as shown in Fig. 5 The tubes *Y* and *Z* are used as half-wave rectifiers, one supplying the plate voltage, and the other the grid voltage. When used as rectifiers, receiving tubes should have the grids and plates electrically connected together. A special transformer *M* with six windings is used. Two of the windings, *G* and *J*, supply the filaments of the two rectifier tubes. A third, *I*, the filaments of the recorder tubes. A fourth, *U*, the high voltage for the plates. The fifth, *L*, supplies the grid voltage, and the sixth, *E*, is the 110-volt primary winding. The rectified alternating current is smoothed out by means of four-microfarad condensers, *P*

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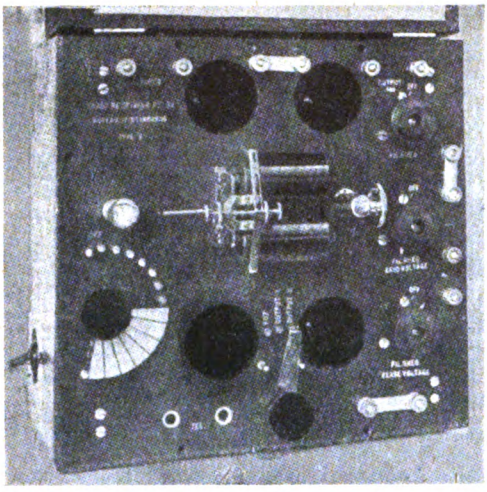

*Fig. 6. Type B Relay Recorder for use on the 110-volt A.C. supply.*

and *R*, connected across the output terminals. As the currents in the grid and plate circuits are small, smoothing out inductance was found unnecessary. It was found necessary to put 40,000 ohms as shown at *O*, across the output circuit of the rectifier tube supplying the voltage to the grid, as the grid is otherwise insulated from the filament of tubes *K* by the rectifier tube. By means of the filament rheostats, *X* and *W*, the grid and plate voltages may be varied over any ranges desirable for the most efficient operation of the recorder. By the use of binding posts with straps, as shown in Fig. 6, the type *B* recorder may be operated from filament, H.T. and grid batteries for supplying the filament, plate and grid voltages respectively in cases where the A.C. supply is not available.

In cases where very high-speed operation is desired, the ordinary relay may be replaced by one designed for high-speed operation.

# Manchester's 1 kW. Amateur Station

By A MEMBER.

APROPOS of the success attained by Mr. W. R. Burne, of the Manchester Wireless Society, in gaining the first prize in the recent transatlantic receiving test, Mr. Y. W. P. Evans, Hon. Secretary of the Society, suggested that an effort be made to get into touch with the American amateurs by means of a special transmitting plant to be erected by the members.

A formal application was made to H.M.

*Laying out the mast preparatory to erecting.*

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Postmaster-General for permission to use an input of 1 kW. and special aerials.

The preliminary details were forwarded to London, with the application, in March, and

*The mast nearing the vertical position.*

after consulting the various government departments concerned, facilities were granted by the Post Office authorities whereby the Society would be allowed to make a special test extending over a period of two to three days, using the 1 kW. transmission power.

It was obvious that to make the attempt in midsummer would be asking for failure or practically so, observing that most American amateur stations reported excessive atmospherics and consequently were closing down, as far as long distance work was concerned.

Not wishing to abandon the idea of a test, it was decided to modify the original application by asking for a special licence to cover a period of twelve calendar months from June 1st, 1922, and up to the time of writing this had not been confirmed.

Whilst these various negotiations were in progress the members of the Society were busy erecting the station. Difficulty was at first experienced in the choosing of a suitable site. Altogether eight different sites were offered, all having certain advantages and a supply of A.C. or D.C., on the spot. Eventually, Mr. J. H. Brown (Vice-President), of Redbrook, Baguley, very generously offered to purchase a plot of land about one and a half acres in extent, and loan this to the Society for an indefinite period, and this site was finally chosen. A committee of four members was elected for the purpose of working out the approximate cost of the station and after allowing a suitable margin for sundry expenses, this was estimated at £120. A working committee of twelve members was then formed and invested with the authority to design a 1 k W. station at a minimum cost.

The masts were the first consideration and these, it was decided, should be 80 ft. high, consisting of two 40-ft. poles, 6 to 3 in. taper, surmounted by five 8-ft. socketed steel sections. The first method of raising this mast was of simple design consisting of two 12-ft. ground timbers, 6 ins. by 3 ins., sunk to a depth of 6 ft., 6 ins. apart. Two holes were bored at a height of 4 ft. from the ground, and a similar hole through the wooden pole at the same height from the base. A bolt was then passed through these holes, the foot of the mast being raised accordingly, so that it was pivoted at a point 4 ft. from its lower extremity and 4 ft. from the ground. Stays were fixed at equal intervals along the mast and brought to a common point, being secured together by means of a rope strop which was hooked in the one-ton hauling blocks, the other end of the blocks being secured to a double line between two trees at a height of 20 ft. from the ground. The mast was then raised to an angle of 20 degrees by means of ladders and very gradually worked up until the strain of the whole mast could be taken by the blocks, this position being with the mast at an angle of 40 degrees. Three ladders were used, 20 ft., 30 ft., and 45 ft., the latter two were now removed and each side stay manned by two members, slowly the weight was taken and a good 45 degree angle obtained. This was the most critical point, and consequently

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the greatest strain was exercised at this moment. The wooden mast proved unequal to the task and after buckling slightly at about 30 ft. from its base the whole mast collapsed, fortunately without any casualties.

From this moment the system employed for raising the mast was abandoned, and after the working committee had reviewed the situation it was decided to adopt the falling derrick principle. Mr. Hallam constructed a model mast and derrick to scale, equal to an 80-ft. mast with a 30-ft. derrick, and working from this he demonstrated that with a 2 lb. weight at the top of the model mast, a pull of 6 lbs. was registered on the spring balance for the first pull, gradually diminishing until the falling derrick balanced the mast proper, after which the mast assumed an upright position quite easily. Material being obtained, the second mast was constructed and consisted of three 27 ft. sections of 3-in., 2-in., and 1½-in. steam piping, with a falling derrick 30 ft. long of 3- n. piping.

*A group of Members of the Manchester Society and Friends.*

The stays were measured off to the exact length on two sides and made secure to stakes driven obliquely into the ground, the back set of stays being made fast to the head of the derrick. The blocks were then fixed to the derrick and a pull taken from a section of the broken wooden mast, which had been previously laid to rest in a 3 ft. trench, around which was a steel rope strop.

Everything being in readiness, the mast was raised comfortably by six of the members, and lent itself readily to adjustment by means of the bottle screws in each stay. The second mast was constructed of eleven 8-ft. socketed steel sections, 3 ins. in diameter and raised in precisely the same manner as the three-section mast. On this mast, four sets of stays were necessary owing to the number of sections used and adjustment was much more difficult than with one of fewer sections. A six-wire aerial was next constructed, pending the authority of the P.M.G., and this was erected on 6-ft. star spreaders. The two end spreaders were made up of six ½-in. canes, 6 ft. long, three couples being lashed together and these double lengths secured at the centre, forming a six-point star, 6 ft. in diameter. The four intermediate spreaders were made of three single ½-in. canes similarly arranged. The lead-in was made on the same lines, with 6 in. three-ply discs, ⅜-in. thick as spreaders. The peripheries of these were divided into six, at each point of which a slot was cut, ⅛ in. wide and ⅜ in. deep, the centre section of three-ply was turned out to a depth of ¼ in., thus forming a channel around which binding wire could be secured after fixing the six lead-in wires in the slots. The total length of wire in the aerial is 660 ft. and in the feeder 618 ft. of 7/22 enamelled with 1/18 core. The total cost of the work above described was approximately £40.

The next item was the earth, and it was decided to dig a trench 5 ft. deep by 3 ft. wide between the masts, and as there is water at this depth it was considered to be a better system than counterpoise wires which had at first been proposed. Four ¼-in. copper conductors were laid in the trench and a connection taken from the centre of each to the transmitting room. The area covered by the water at a depth of 5 ft. is roughly three to four acres, so that this may be said to constitute the earth. It is damp all the year round, thus ensuring a constant earth resistance. The above work was carried out by about 30 to 40 members at week-ends, and is really very creditable to so small a society (145 members).

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# How to Get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.

(Author of " The Maintenance of Wireless Telegraph Apparatus.")

### V. THE HIGH TENSION BATTERY AND ITS MAINTENANCE.

WHILE many amateurs and beginners exercise considerable care in regard to their accumulators, the high-tension battery is often carelessly chosen. In this, as in practically everything else in wireless, you get just what you pay for. And seeing that faults in the high tension supply are not readily recognised, trouble arising from this source is often neglected.

The first consideration in choosing a high tension battery is, what voltage is needed for the particular valve or valves in use? Whilst most valves are sold for given voltages, much depends upon the use to which the valve is put, and the circuit in which it is used. The popular hard " R " valve will work quite well as a detector with forty to fifty volts on the plate, but sixty to eighty may often give better results. When used as a high frequency amplifier with transformer or reactance capacity coupling, the same voltage can be used, but with resistance-capacity coupling a hundred volts will not be found too high. When valves are advertised for certain voltages, no account is taken of the drop in voltage in resistance-capacity couplings, and if such couplings are used the voltage must be increased thirty to fifty per cent. to obtain the best results. The QX valve, which works well as a detector with 25 to 30 volts on the plate, needs 60 to 80 if used in reactance-capacity or transformer coupled amplifying circuits, and 100 with resistance coupling.

High tension batteries are sold in several forms. Very popular and useful are the 15-volt units now made by several firms. It is very convenient to make a wooden box to hold four units side by side, and to place the batteries with their unlike poles together, so that short wires can be soldered on to the lugs to make the necessary series connections. Connection should be permanently made to one end of the series, the other connection from the set being a flexible lead, terminating in a spring clip which can be clipped on the end of the first, second, third or fourth unit.

Some makers sell high tension units with tappings for every three volts, and plug connections for the desired points. These are also useful but are naturally more expensive. Very close adjustment of the plate voltage is not often required, variation of the filament brilliancy being all that is sufficient for fine adjustment in most cases. Personally, I have given up the " wander plug " type in favour of the 15-volt units, as the former do not seem to me to be worth the additional cost.

The individual cells in a high tension battery should not be too small, as although very little current is taken from them the utmost steadiness is required and this cannot be obtained with very small cells. Further, the larger cells last much longer and the cost of high tension batteries *per annum* (the only true way of comparing values), is always lower if good cells of fair size are purchased in the first place.

If a high tension battery is bad, failing or worn out, it gives evidence of its state by noises which are frequently taken to be atmospherics. To test whether the noises are due to atmospherics or to faults in the receiver itself, disconnect the aerial and see if they still continue. If they cease, they are invariably due to causes outside the receiver. If they continue, they may be due to bad connections, bad valves, faulty grid leak or coupling resistances, faulty low tension battery, faulty low or high frequency transformers, or more likely than any of these, to one or more faulty cells in the H.T. battery.

To remedy the trouble, if 15-volt units are used, cut out each unit individually. More often than not the fault will be in one unit only, and this should be discarded and a new unit put in place. With " wander-plug " batteries take a short length of wire and quickly tap each successive pair of contacts, being careful not to short them for more than a moment at a time. Usually the noises will cease when one pair of plug sockets is shorted. The bad cells thus found can be permanently shorted in any convenient way, such as by two spare plugs connected by a length of wire.

High tension accumulators made up of tiny secondary cells are obtainable. They are much more expensive than the dry cell type, and, of course, must be periodically charged. High tension wet batteries of the " leclanche "

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type are also on the market. The results obtainable with both are good, and the reader can judge for himself whether in his particular case the advantages outweigh the disadvantages. The first cost is high, but in the long run they are both probably cheaper than the dry cell type, although rather messy.

A fixed condenser connected across the high tension terminals of a receiver is always an improvement. The value should never be less than 0·01 mfd. and is better much larger. This condenser serves the double purpose of preventing high frequency current passing through the battery (this always does harm) and smoothing out slight irregularities in voltage.

It is usually better to use separate H.T. batteries for note magnifiers. A common H.T. battery for several valves is a fruitful source of interaction and howling.

Finally, buy your H.T. batteries from a maker of repute and from a dealer whom you know to keep his stocks fresh.

# Notes

### Clifden Receiving Station Destroyed.

Marconi's Station at Clifden, West Galway, which had been held by Irish rebels for a few days, was put out of action on July 25th. The Receiving house was soaked in petrol and burned. We understand its work has now been transferred to Ongar, Essex.

### New Berne List.

Le Bureau International de L'Union Telegraphique, Berne, is publishing a new list of stations arranged alphabetically. Persons desiring to obtain the list, including supplements covering 1922 and 1923, should send to the Bureau International six Swiss francs.

### Memorial Service to Cardiff Student.

A memorial service was held at St. John's Church, Canton, on July 16th, for the late Mr. Eric Preen, a student of the Cardiff Wireless College. Mr. Preen was drowned on his first sea voyage.

### New Companies.

We note that the Ashley Wireless Telephone Company of Liverpool, and the Wrent Mores Amalgamated Engineering and Construction Company have just been formed. The Ashley Company has a capital of £50,000 in £1 shares, and the Wrent Mores Company's capital is £12,500. The objects of these two new concerns are both on wireless lines, the former dealing in telephone apparatus, the latter carrying on business as electrical and wireless engineers.

### Broadcasting Licences.

The Postmaster-General said in the House of Commons on July 27th :—

"No licences have yet been issued to establish broadcasting stations, but I understand that the principal manufacturers of wireless apparatus in Great Britain will combine to form a company or companies to provide broadcasting services. Any *bona-fide* manufacturer in this country will be admitted to membership of any company so formed, and the companies will make themselves responsible for raising the necessary capital and maintaining efficient services. It is proposed that the receiving apparatus which may be used under the licence shall be limited to types submitted by members of the broadcasting companies, and that it should conform to certain technical standards.

"I have been informed that the broadcasting companies, when formed, will probably desire to impose on their members the condition that British-made apparatus only shall be sold by them, and I have intimated that I will assent to this condition for a period of two years. It will rest with membership of the companies to determine to what extent this condition shall apply to the component parts of the apparatus.

"The functions of the Post Office will be limited to approving types of apparatus submitted by members of the company, and inspection of individual sets will not be necessary. Provision will be made under which amateurs who construct their own receiving sets, and licensees who have already purchased imported receiving sets, will be allowed to use them.

"The revenue required for providing the services will be derived partly from a contribution by the manufacturers to the company on each set sold by them, and partly by a proportion of the annual licence fee, which I shall propose to the House shall be paid to the companies financing the services. The cost of erecting the stations and providing these services is likely to be considerable, and I have received no intimation from any firm that they are willing to undertake it without guarantee or payment."

### Mersey Dock Music Discontinued.

The Postmaster-General has forbidden the sending of musical items from the Mersey Docks and Harbour Board's telephone station at the Dock Office. The musical items which have hitherto been given at about 9 o'clock each evening have therefore been discontinued.

### Reservation of Wavelengths.

Mr. Pike Pease said in the House of Commons that steps had been taken to reserve for the Empire the right to use certain wavelengths necessary for long distance transmission.

### First Sermon by Wireless.

Dr. J. Boon, President of the Peckham Christian Union preached a sermon to his congregation on Sunday, July 30th, by means of wireless telephony from the station of Mr. W. W. Burnham at Blackheath.

### French Agricultural Service.

For the benefit of agriculturists the Ministerial Council has decided that the Eiffel Tower shall transmit weather reports three times a day. Receiving sets are to be erected by the Mayors of every locality in order to pass on to farmers the information which may be of use to them.

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# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with interest this morning the article on Major Armstrong's new super-regenerative receiver. I have not had the opportunity of testing the circuit myself yet, owing to lack of the necessary components, but I have a friend in Newark, N.J., to whom I am indebted for the following information re this receiver and thought that it might be of sufficient interest for you to publish for your readers.

The valves used should be capable of taking a plate potential of at least 90 volts and the higher this can be raised, the greater the volume of sound produced in the telephones. The American UV-202 is suitable, but doubtless the M.O. Valve Co. produce similar valves.

If an entirely new receiver is desired to be built up then the arrangement shown in the figure is perhaps the most convenient

$C_1$ and $C_2$ = 0·001 mfd. (or more).

The coils $L_1$ and $L_2$ may be plug-in type of the Burndept short wave series and are varied according to the wavelength to be tuned to.

$L_4$ and $L_5$ may be Burndept coils Nos. 1000 ($L_4$) and 750 ($L_5$), and of course, do not vary with wavelength changes occasioned by $L_1$, $L_2$ and $L_3$ (a variometer).

An outdoor aerial may, of course, be used instead of the loop, but if both are used together then interference from other stations on a slightly different wavelength may be entirely eliminated.

The outside aerial is loosely coupled to $L_1$ by a coil about the same size as $L_1$, and has a variable condenser of 0·001 mfd. in series for tuning. The coupling may vary with somewhat different sized aerials.

The desired signal is then tuned in on the loop and the outside aerial is tuned to resonance with the interfering signal and then the coupling between the aerial coil and $L_1$ is gradually increased until the jamming signal is balanced out.

The sensitivity of this receiver being so great, loop antenna reception is possible and atmospherics can almost wholly be eliminated.

JOHN C. STOTT.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—On June 20th, at 8 p.m., while I was listening-in on 750 metres, I heard telephony in English by **5 BO** working to **5 CH**. Can you or any of your readers tell me who these are? Speech was excellent even under very trying conditions, viz., jamming by spark stations, condenser-turning fiends (I heartily endorse the recent letters by M. J. G., Mr. Banks and Mr. Whiteside and others on this subject), and the hash from Leafields arc. The latter is especially bad here, as, of course, I am situated less than 20 miles from Leafield, but it is particularly annoying in all parts of the country and it is quite unnecessary for me to describe what unfortunately is heard from this station which is "the latest production of an up-to-date country." Might I suggest that a petition be sent to the P.M.G. (say through the Wireless Society of London), asking that transmitting be done by valves instead of the present arc. It is, of course, appreciated that harmonics would still exist but it is what is rightly described as the "hash" of the arc that is so particularly troublesome.

I have just been listening to **2 LO** sending out a most excellent programme by members of Dalys and the Lyric theatres, to St. Dunstan's, which was punctuated by the hash, and if this is allowed to continue when broadcasting becomes general, I would advise amateurs around this part of the country to keep their money in their pockets.

G. COURTENAY PRICE (**2 OP**).

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—A conference of Midland Wireless Clubs is being promoted by this Club, with a view to discussing the interchange of lectures, and other matters of mutual interest.

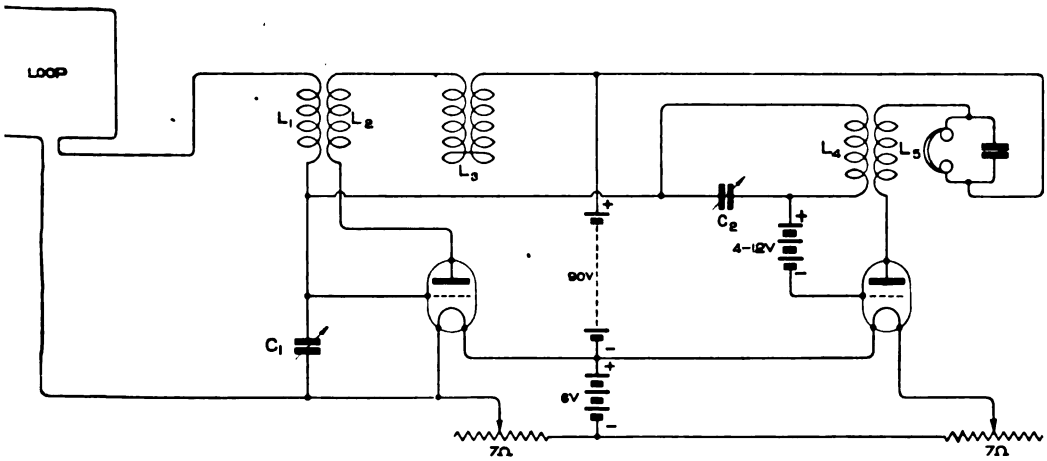


*Diagram of the Armstrong Super-regenerative Circuit referred to above.*

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It is proposed that the conference shall be held in Birmingham, as early as possible in September, and all Midland clubs are invited to send delegates. I shall therefore be very glad if secretaries of such organisations will communicate with me at the earliest possible date.

FRANK S. ADAMS,
Hon. Secretary.
Birmingham Experimental Wireless Club.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With the advent of wireless broadcasting there is, without doubt, a very great number of the public, both young and old, who desire to become more conversant with this branch of science. Also there will be a vast number of "home" installations set up; some will be of a very simple character, whilst others will be of more or less elaborate construction, according to the abilities of the person launching out to fathom the æther. There will, of course be many difficulties to be overcome before any kind of apparatus of home construction is completed. For the person who does not desire to know anything more of wireless than the manipulation of a "fool-proof" receiving instrument, much cannot be said, but for the genuine experimentists, who wish to discover or know the "why and the wherefore," there is something to be said, i.e., there is help awaiting them, if they will only avail themselves of the opportunities which are open for them.

This help may be found in any of the Amateur Wireless Societies or Associations of which many now exist, and those which have been in existence for any length of time have been affiliated to the Wireless Society of London. Of course, no one is under any obligation, at present, to join such an Association, if they are going in for the reception of "Broadcasting" Just one further point, and one that cannot be too strongly emphasised: It is certainly most advisable for any person who anticipates using valve circuits or apparatus to become acquainted both theoretically and practically with them before endeavouring to search the æther, for if one has not attained even the most elementary knowledge of the functions of the oscillation valve, then there is a likelihood of causing disturbances in the æther that neither themselves or others will get much enjoyment for their labours. The writer will be very pleased indeed to answer any enquiries respecting the Association to which he is the Hon. Secretary.

HORACE W. COTTON,
Hon. Secretary.
The West London Wireless and Experimental Association.

19, Bushey Road,
Harlington, Middlesex.
21*st July*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—There must be a number of amateurs having receiving apparatus of their own construction who, not being able to get an opportunity of comparing their results with those of others more experienced by actual listening-in on other sets, would welcome some reports through your columns on results obtained by other people.

Low power telephony is a subject in which we are all interested and it would be a great help to many to know at what distance it should be possible to receive the telephonic transmissions of amateurs using 10 watts or less, on a single valve.

Perhaps some of these gentlemen who hold transmission licences and who give us much pleasure by their excellent music, would kindly publish the distances they regularly work when using one, two, three or more valves.

ROBERT G. ELLIS.

# Calendar of Current Events

**Sunday, August 6th.**

Transmission of Telephony from 8 to 9 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, August 7th.**

SOUTHEND AND DISTRICT WIRELESS CLUB.
Garden Fête and Public Demonstration in the Rectory at Leigh-on-Sea.

**Wednesday, August 9th.**

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

**Thursday, August 10th.**

Transmission of Telephony from 8 to 9 *p.m.* on 1,085 metres by **PCGG**, The Hague, Holland.

ILKLEY AND DISTRICT WIRELESS SOSIETY.
7 *p.m.* Regent Café. Meeting.

STOCKTON AND DISTRICT AMATEUR WIRELESS SOCIETY.
Monthly Meeting.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
No meeting. (Closed until August 31st.)

ILFORD AND DISTRICT RADIO SOCIETY.
At St. Mary's Hill, High Road, Ilford. Lecture on "Reaction," by Mr. J. F. Payne.

**Friday, August 11th.**

SOUTH SHIELDS Y.M.C.A. AMATEUR WIRELESS SOCIETY.
8 *p.m.*, at Y.M.C.A. Buildings, Fowler Street, South Shields. Meeting.

**Sunday, August 13th.**

Transmission of Telephony in afternoon and from 8 to 9 *p.m.* on 1,085 metres by **PCGG**, The Hague, Holland.

**Tuesday, August 15th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2 MT**, Writtle, near Chelmsford.

WIRELESS SOCIETY OF EAST DORSETSHIRE.
At Branksome Liberal Club, Salisbury Road, Upper Parkstone. General Meeting and Enrolment of Members.

**Wednesday, August 16th.**

YORK WIRELESS SOCIETY.
8 *p.m.*, at Grand Picture House Café, Clarence Street, York. Preliminary Meeting.

**Thursday, August 17th.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Transmissions from 2 LO.**

We understand that **2 LO** may transmit on August 7th from 5 to 5.30, 6 to 6.30, on August 9th and 10th 5 to 5.30, 6 to 6.30, 7 to 7.30.

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*To the Edito*
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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## Newcastle and District Amateur Wireless Association.*

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

On Monday, July 10th, an Ordinary Meeting was held. After the committee had finished business in private an address was given by Mr. Mason on his experiences and difficulties during the development of his present receiver (a four-valve circuit, using two high frequency, tuned transformer method of coupling). Several of his remarks were severely criticised by members present. The criticism, however, as usual, proved of benefit and interest. Mr. Dixon rose and dealt at length with the various methods of connecting the individual windings of the transformers, and with the inter-relationship of the windings of the transformers following in the circuit. The remarks passed by critics were very instructive as to the effect of the reduction in transmitting wavelengths down to 180 to 450 metres. It appeared that the tuned transformer method had been giving much disappointment (so far) on the shorter waves. Transmissions from Marconi House (2 LO), Writtle 2 MT), and various amateurs had all been received so weak as to be useless (that is, when anything had been received at all).

The majority of members seemed to be turning to the variometer type of regenerative circuits. Experiences with the Reinhartz tuner showed many desirable features, including very sharp tuning with complete absence of undesirable capacity effects from the body and hands.

After the minutes of the last general meeting had been read and passed, the Chairman called on Mr. Colin Bain to deliver his lecture upon the relationship between wavelength and frequency. Mr. Bain dealt with the subject in a most interesting and lucid manner, chiefly in order to assist those members who have but recently joined the ranks of wireless experimenters.

Mr. Dixon, the Chairman, then lectured on the various oscillations produced in "Spark" transmission, giving a very detailed account of the production of wave trains, dealing first with the induction coil, the the spark gap, and finally with the oscillations between the aerial and earth. He then explained the systems used by some of the large commercial spark transmitting stations, and the wave effects produced from each, illustrating each section of his lecture with very clear diagrams.

A discussion followed upon the peculiar action of a tapped high frequency transformer, which gave three high efficiency "peaks" at different wavelengths for the first tapping. Further experiments are being carried out with this transformer, the results of which, when completed, will be explained to the members.

A meeting was held on Monday, July 17th, at Headquarters, Wireless School, Eldon Square.

## Birmingham Experimental Wireless Club.*

Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham.

At a meeting held at Digbeth Institute on Friday, July 14th, Mr. L. J. Dore lectured on "Condensers in Radio-Circuits." The President (Mr. A. L. Lancaster) took the chair.

Mr. Dore commenced with the electroscope as a means of detecting static charges, and gave a description of the action of a condenser. He then described a large number of different methods of constructing condensers, which could easily be used by amateurs. Many of the ideas described were extremely ingenious, particular reference being made to methods of obtaining fine adjustment.

Some particulars were then given of the uses to which condensers could be put in valve circuits, and the functions which they performed when inserted in various positions. A discussion followed, in the course of which regenerative and retroactive circuits were drawn on the blackboard, and their relative advantages discussed.

Mr. Dore, who is a vice-president of the Club, was unanimously accorded a vote of thanks.

A new financial year commenced on August 1st. Intending members are advised to communicate with the Hon. Secretary.

## The West London Wireless and Experimental Association.*

Hon. Secretary, Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

A meeting was held on Thursday, July 20th. Morse practice was given by Mr. R. T. Wright and several members availed themselves of the opportunity to brighten up their reading.

Owing to the large number of new members now joining the Association, Mr. J. F. Bruce commenced a series of elementary instructional chats, which dealt with inductances in various forms and methods of construction. In turn he minutely explained the making of formers, the winding, various methods of tapping, finishing and mounting of coils, and gave some data for a very efficient loose coupler, which from personal use and experience he has found most effective and efficient. Mr. Bruce was shown how his chatty lecture was appreciated by the round of applause which burst forth when the President asked the assembly to express their hearty thanks. The next "chat" of this series will be "Single Valve Panels" and "Reactance Inductance." Owing to so many members taking their annual vacation just now the committee desire all members and prospective members to note that the next meeting will not be held until Thursday, August 31st next, at the Club Rooms, Belmont Road Schools, Chiswick,

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W.4. The Secretary will be pleased to reply to all enquiries from intending members, respecting objects and subscriptions to the Association.

### North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, N.21.

The 93rd meeting of the Club was held at Shaftesbury Hall, Bowes Park, on July 12th. As previously announced, a special instruction class for beginners was held from 7.30 p.m. to 8.30 p.m., when the chair was taken by Mr. A. G. Arthur, the President of the Club.

Owing to pressure of business, the Hon. Secretary was unable to be present, and in consequence many duties, such as interviewing prospective members, which usually fall to the Secretary, devolved on Mr. Holton. Having received from a correspondent, Mr. Vincent, in India, a very interesting booklet, containing the results of his researches on atmospherics, Mr. Holton read these out to the audience. A very interesting discussion then resulted on the origin of these atmospheric disturbances. Mr. Holton explained the nature of lightning, as far as is understood, and showed how a lightning arrester works. Mr. Wordham also contributed to the discussion, and explained how he had endeavoured, with considerable success, to screen his aerial from interference from high tension overhead wires.

During the evening four new members were declared elected.

Particulars of the club may be had on application to the Hon. Secretary.

### Wakefield and District Wireless Society.*

Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Wakefield.

A meeting of the above was held at 8 p.m. on July 21st, at the Y.M.C.A., Grove Road. Mr. H. A. T. Burbury (President) was in the chair. About 40 members were present.

The minutes were read, after which Mr. Burbury, jnr., ably dealt with "The Formation of a Valve Receiver," in a clear and concise manner, with blackboard illustrations.

Questions were then put and answered, on different difficulties that had attended members' sets, the answers to queries being both interesting and edifying.

A hearty vote of thanks was expressed to Messrs. Burbury for their joint kindness in making the meeting such a success.

The Hon. Secretary will be happy to receive names of prospective members.

### South Shields Y.M.C.A. Amateur Wireless Society.

Hon. Secretary, Mr. J. Teasdale, 38, Readhead Avenue, Westoe, South Shields.

The above Club has now been formed, and a single-valve receiver has been installed.

Intending members should communicate with the Secretary or attend any of the meetings, which are held every Friday, at 8 p.m. in the Y.M.C.A. Buildings, Fowler Street, South Shields.

### Port Talbot Wireless Club.

Mr. T. E. Nicholas, 22, Beverley Street, Port Talbot, Glamorganshire, would be glad to receive communications from those in his district who are desirous that a society or club shall be formed. Amateurs particularly are requested to write direct to Mr. Nicholas.

### The Dewsbury and District Wireless Society.

Hon. Secretary, Mr. A. Horsfall, Willow Grove, Lee Street, Ravensthorpe, Dewsbury.

On July 13th a General Meeting was held in the society's rooms in South Street, Dewsbury, at 7.30 p.m., the President, Mr. S. S. Davies, presiding over a good attendance of members.

The chief items under discussion were the new rules and suggestions for Morse classes; the first item was speedily dealt with, and the arrangements for Morse classes are that a class be formed and meet on Thursdays at 7.30 p.m. to receive instruction and buzzer practice. Mr. C. J. Johnson (a member of the committee) will instruct, and it is hoped that a good number will take advantage of these classes.

At the close of the business a lecture was given by the President, his subject being "How to Make a Single Valve Receiver."

The lecturer first enumerated and explained all the necessary gear, and by diagrams and practical demonstration made it quite clear how a single valve receiver could be made and work efficiently at a moderate cost.

The lecture was most interesting and profitable to those members who are constructing their own sets. At the termination of the lecture an interesting discussion followed, after which the usual vote of thanks was accorded the lecturer, which was suitably acknowledged.

### The Malta Radio Society.

Hon. Secretary, Mr. Paolo Bonnici, Workers' Union Headquarters, S. Santa Lucia, Valetta, Malta.

A wireless society has been formed under the above name. The committee consists of:—President, Senator Zammit-Hammet; Vice-President, Mr. E. Tonna-Barthet, F.R.Met.Soc., M.B.S.E.; Hon. Secretary, Mr. P. Bonnici; Hon. Treasurer, Mr. E. Xerri; General Member, Mr. R. Galea, M.B.S.E., Stud.I.E.E.

The present number of members is 22, but this figure is steadily increasing.

### Paddington Wireless and Scientific Society.

Hon. Secretary, Mr. L. Bland Flagg, 61, Burlington Road, Bayswater.

The above Society held their first field day on Sunday, July 16th, at Stanmore, Herts, and, taking into account the inclement weather, a very enjoyable day was spent.

During the day the members were able to hear through the medium of a nine-valve H.F. amplifier, to which was connected another amplifier (three-valve L.F.) and a loud speaker, some excellent signals and music, which were thoroughly enjoyed by a large and appreciative audience.

The Committee tender their thanks to the following gentlemen for the loan of apparatus: Dr. Eccles, F.R.S., of Finsbury College, who kindly lent the nine-valve amplifier, and Mr. L. McMichael, M.Inst.R.E., of Kilburn, for the loan of the L.F. amplifier.

To Capt. Palmer, of the Stanmore Brewery, Stanmore, the members are very grateful for the use of the park known as "The Grove," Stanmore, where the apparatus was installed, and which was protected from the elements by a spacious pavilion.

A further field day is being arranged for August 20th, of which an announcement will appear in Calendar of Current Events.

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### The Leicestershire Radio and Scientific Society.

Hon. Secretary, Mr. J. R. Crawley, 269, Mere Road, Leicester.

The monthly meeting of the above Society was held on Monday, July 17th, at Headquarters, Vaughan College. The President, Mr. C. T. Atkinson, was in the chair. The usual business was transacted, together with certain special matters of great interest to all. Two new members were elected. The President then called upon Mr. J. W. Pallett to read his paper on "Continuous Wave Transmitters." With the aid of diagrams, Mr. Pallett showed a number of circuits as used in practical C.W. work and concluded with a selection of slides kindly lent by the Marconi Co., depicting various types of actual gear, including the well-known **2LO.**

The paper was given in the characteristic style of its author and at the conclusion a hearty vote of thanks was given to Mr. Pallett, proposed by the President, and seconded by Mr. H. E. Dyson.

All communications should be addressed to the Hon. Secretary.

### The Hornsey and District Wireless and Model Engineering Society.

Hon. Secretary, Mr. H. Davey, 134, Inderwick Road, Hornsey, N.8.

A meeting of the above Society was held on July 18th, 1922, at 29, Felix Avenue, Weston Park, Crouch End.

The first demonstration of the club set was given. A good selection of Morse messages were heard and taken down by advanced members, also all members enjoyed the music, etc., from **2MT** and **2FQ.** The set is of the progressive type, mounted so as to be convenient for fixing to wall or to stand on a table. The set at present consists of a rectifying panel and single note magnifier, with positions for adding high and low frequency amplifiers. All connections are made in such a fashion and with different coloured insulated wire, that the circuits can be easily traced.

Meetings of this Society are held on Tuesdays and Fridays, at 7.30 p.m. New members are cordially invited. A series of lectures for beginners has just been started.

### Hackney and District Radio Society.

Hon. Secretary, Mr. E. R. Walker, 48, Dagmar Road, South Hackney, E.9.

A meeting of the above Society took place at 111, Chatsworth Road, Clapton, at 8 p.m. on July 20th. A large number of members were present. Nine new members were enrolled during the evening. Mr. D. R. Ison opened the meeting with Morse instruction. He then proceeded to lecture on the "Three Electrode Valve" and showed how the filament, on becoming incandescent, discharged electrons, and how these were controlled by the grid. The subject was capably handled and made clear even to the beginner.

Numerous questions were asked and an animated discussion followed, showing how keenly enthusiastic were the members. Later on a lengthy discussion on accumulators took place.

On July 27th, Mr. Valins gave a demonstration and lecture on H.F. currents, Tesla coils, and Wimshurst machines.

Those desirous of joining should write to the Hon. Secretary or apply personally at 111, Chatsworth Road, Clapton, Thursdays only.

### York Wireless Club.

In connection with the formation of a Society in the York district a meeting has been arranged for August 16th, at 8 p.m., at the Grand Picture House Café, Clarence Street, York, to discuss the organisation.

Mr. White, Grand Buildings, Clarence Street, York, will be glad to give any information to interested persons, and to receive any suggestions which may be offered.

### The Lowestoft and District Wireless Society.

Hon. Secretary, Mr. L. W. Burcham, "Gouzeacourt," Chestnut Avenue, Oulton Broad.

The above Society has not been by any means inactive. The lectures that have been given include "Earth Currents and their Detection," the lecturer dealing with his work in France in a very interesting and at times amusing way. Another lecture dealing with the work in France was "Sound Ranging." This lecture, although not dealing with wireless, nevertheless proved very interesting and showed how British science played a great part in winning the war. Another interesting evening was also spent on a discussion on short wave reception and the efficiency of the Reinartz tuner.

It is with much regret that the Committee have to announce that the proposed exhibition for August 3rd and 4th has had to be postponed indefinitely owing to the unsettled conditions prevailing in the manufacturing wireless line.

The membership of the Society has increased considerably in the last month or so but there is still room for more.

### Fulham and Putney Radio Society.

Hon. Secretary, Mr. J. W. Dewhurst, 52, North End Road, West Kensington, W.14.

The above Society has been recently formed and held a meeting at their temporary headquarters on Wednesday, July 19th. Considerable business was done regarding starting the Society on a proper basis, the officers were elected, the subscription fixed, and the meetings arranged for every Thursday evening at 7.30 p.m. Also it has been proposed to start a technical library and workshop for the use of the members. There is an aerial fitted to the Society's headquarters and the founder, Mr. Houston, has promised a valve panel and other apparatus. The standard will not be too high for the beginner and yet a good selection of experienced amateurs have joined as members and the Committee will cater for both. An elaborate programme is being prepared for the coming season and prospective members of both sex are invited to write to the Hon. Secretary for particulars.

### The Wireless Society of East Dorsetshire.

Hon. Secretary, Mr. E. T. Chapman, I.R.E., "Abbotsford," Serpentine Road, Poole.

On Tuesday, August 15th, at Branksome Liberal Club, Salisbury Road, Upper Parkstone, a General Meeting is to be held, and new members will be enrolled.



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**Sheffield and District Wireless Society.***

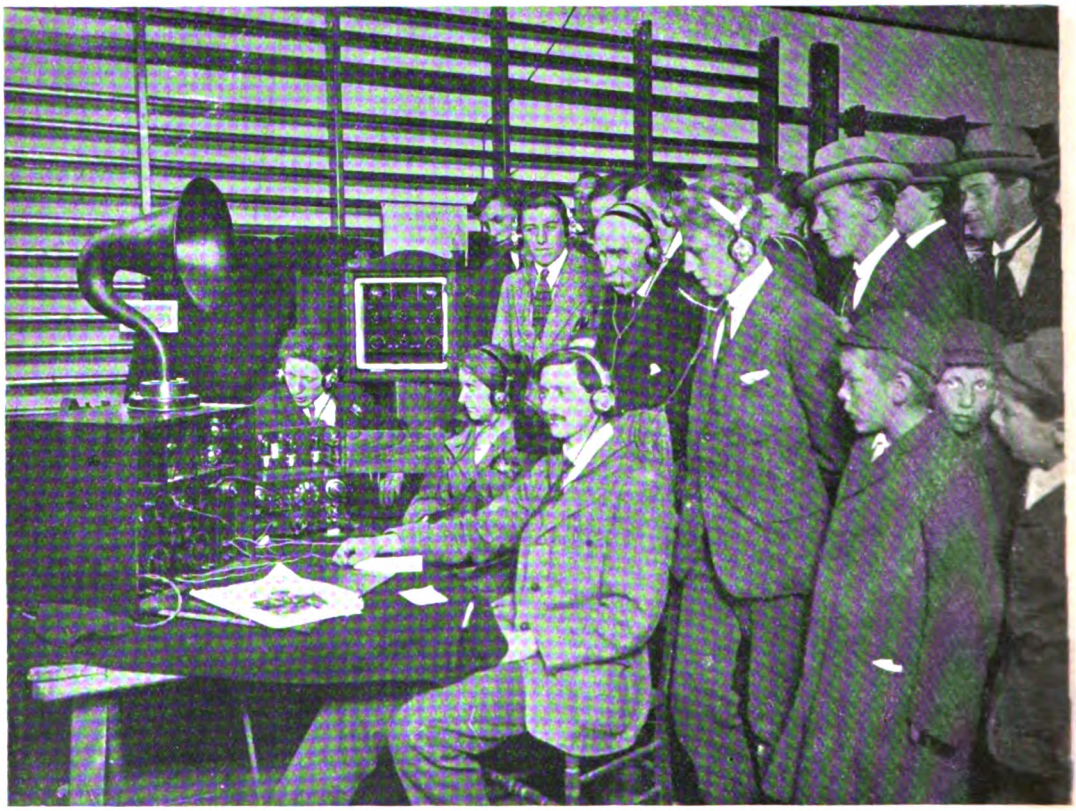
Hon. Secretary, Mr. L. H. Crowther, A.M.I.E.E., 156, Meadow Head, Norton Woodseats, Sheffield.

In accordance with a pre-arranged programme, on Sunday, July 16th, 20 members, including two ladies, of the society journeyed to Castleton for the purpose of carrying out experiments with a portable apparatus in the famous Blue John mines of Derbyshire. Although the ascent of Mam Tor Road and crossing to the entrance to the mine was made in heavy rain and high wind, everyone cheerfully accepted the adverse conditions, no doubt thrilled by anticipation of the most interesting experiments about to be carried out. Each member willingly carried his share of the gear and other necessary stores, and on arrival at the entrance to the mine was provided with one or more lighted candles. Then a weird descent was made to the "Lords dining room," a cavern 300 ft. below the surface. A short single wire aerial was erected across the cavern 10 ft. from the floor and connected to a low power transmitting and three-valve low frequency receiving set.

The technical committee were quickly engrossed in the operation of getting into communication with Mr. Jakeman at his house in Hope, three miles away. Success was soon attained, and telegraphic messages freely exchanged.

Those who had the unique experience of listening to messages to the accompaniment of the ceaseless noise of unseen underground rivers will not soon forget it.

The results obtained fully justify further and early experiments in working mines which it is hoped will be attempted at an early date.



*A Birmingham Wireless Concert.*

*A novel feature of the Midland Musical Festival held recently at Bournville, Birmingham, was a wireless exhibition and telephonic concert arranged for the entertainment of visitors. The instruments were operated by students of the Stirchley Continuation School, under the able supervision of Mr. A. E. Vick, the wireless instructor of the School.*

*Special music was transmitted to the Festival by prominent Birmingham amateurs, Messrs. Baynton, Whitfield, Rogers, Beresford and Scammell.*

*The Stirchley School is one of the few of its kind to hold a transmitting licence. The wireless class is held on Friday evenings. The students hope to arrange shortly a similar public exhibition and concert at the School.*

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### Burnley Y.M.C.A. Wireless Society.

We are informed by Mr. Arthur L. Critchard, General Secretary of the Y.M.C.A., 11, St. James' Row, Burnley, that a society has been formed with the above title.

### Wireless Society of Hoylake, West Kirby and District.

Mr. T. C. Welding, 6, Marine Parade, Hoylake, Cheshire, has intimated his willingness to convene a meeting with a view to the formation of a society in his district. He will be glad to hear from anyone who is likely to become a member. Communications should be sent direct to the address given above.

### Coventry Wireless Society.

Mr. H. H. Thompson (2 LY and 2 VX), 44, Northumberland Road, Coventry, is forming a society, and would be glad to correspond with amateurs in his district who would like to become members. Those interested should write direct to Mr. Thompson.

### Hereford and District Radio and Scientific Society.

Hon. Secretary, Mr. G. C. Davies, Y.M.C.A., Hereford.

An inaugural meeting was held at the Y.M.C.A., Hereford, on July 31st, when the President, Mr. J. C. Mackay, gave his opening address.

It is hoped that considerable interest will be shown by the amateurs and other wireless people in the district, who will be warmly welcomed at any of the meetings. Particulars of the Society may be obtained from the Hon. Secretary.

### The Anerley Wireless Society.

The fourth general meeting was held at the Society's headquarters, 179, Maple Road, Penge, on Wednesday, July 5th.

The business of the meeting included the election of officers, and Mr. Bailey and Mr. Ford were re-elected Secretary and Treasurer respectively.

The Society will be glad to welcome new members, who can obtain any information, etc., from Mr. G. D. Ford, 63, King's Hall Road, Beckenham.

### Stockton and District Amateur Wireless Society.

Hon. Secretary, Mr. W. F. Wood, 4, Birkley Square, Norton-on-Tees.

This Society held its usual monthly meeting in the concert hall of the Malleable Workmen's Institute, Stockton, on Thursday, July 13th.

The Secretary read the minutes of the previous meeting and discussion arose as to the best methods of using the time at disposal each evening, so as to enable each section to receive the maximum benefit. It was announced that the membership had gone up by leaps and bounds, and a definite time-table was decided upon, which would in a short time cover all grades. Morse instruction will be given each evening and at times that will suit any member.

The business meeting closed at nine o'clock, after which the Secretary gave a short paper entitled "The Transmission of Electrical Energy."

The next monthly meeting will be held on Thursday, August 10th, and the name of the lecturer and his subject will be duly announced.

# The Wireless Telegraphy and Signalling Bill.

*The following is the text of the Bill which amends the Wireless Telegraphy Act, 1904, and makes further provision with respect to the regulation of Wireless Telegraphy and Visual and Sound Signalling.*

BE it enacted by the King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1.—The Wireless Telegraphy Act, 1904 (hereinafter referred to as the principal Act), shall become a permanent Act, and any provision in any Act in force at the time of the passing of this Act which limits the period for which the principal Act is to remain in force shall cease to have effect.

2.—(1) The Postmaster-General may, notwithstanding anything in the principal Act, make regulations—

(*a*) as to the terms, conditions, and restrictions on or subject to which licences or any class of licence under the principal Act are to be granted, renewed, suspended, or withdrawn; and

(*b*) requiring any operators or other persons engaged in the working of wireless telegraphy to be provided with certificates, and making provision as to the manner and conditions of the issue and renewal of any such certificate, including the examinations and tests to be undergone, and the form, custody, production, cancellation, suspension, endorsement and surrender of any such certificate, whether issued before or after the passing of this Act; and

(*c*) for preventing interference with the working of wireless telegraphy by the generation or use of etheric waves for any purpose other than the transmission or reception of wireless messages; and

(*d*) for giving effect to, and securing compliance with, the provisions of any international convention signed on behalf of His Majesty, and any regulations made thereunder, so far as the same relate to wireless telegraphy; and

(*e*) prescribing, subject to the consent of the Treasury, the fees to be paid in respect of the grant or renewal of any licence or certificate.

(2) Regulations under this section may provide that any person acting in contravention of or failing to comply with the regulations or any of them, or the terms, conditions and restrictions or any of them, on or subject to which any such licence or certificate as aforesaid has been granted, shall be liable, on summary conviction, to imprisonment for a term not exceeding three months, or to a fine not exceeding fifty pounds, and, in the case of a continuing offence, a further fine not exceeding five pounds for each day during which the offence continues.



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(3) Subsection (6) of section one of the principal Act is hereby repealed.

3.—Subsection (1) of section two of the principal Act, which makes special provisions as to licences for experimental purposes, shall cease to have effect, and licences for those purposes shall be subject to the general provisions as to licences for wireless telegraphy contained in section one of the principal Act.

4.—(1) A person shall not—

(a) send or attempt to send by wireless telegraphy a message or communication of an indecent, obscene, or offensive character; or

(b) send or attempt to send by wireless telegraphy a signal of distress of a false or misleading character, or a false or misleading message as to a vessel in distress; or

(c) improperly divulge the purport of any message sent or proposed to be sent by wireless telegraphy.

(2) If any person acts in contravention of this section he shall be liable on summary conviction to a fine not exceeding ten pounds, or on conviction on indictment to imprisonment for a term not exceeding twelve months.

5.—The penalty to which a person is liable on summary conviction for an offence under subsection (3) of section one of the principal Act shall be imprisonment for a term not exceeding three months, or a fine not exceeding fifty pounds, and, in the case of a continuing offence, a further fine not exceeding five pounds for each day during which the offence continues.

6.—Any provisions of the principal Act or this Act which are applicable to ships, shall apply also to aircraft, with the necessary modifications, and in particular with the following modifications:—

(1) For the reference to British ships in the territorial waters abutting on the coast of the British Islands there shall be substituted a reference to British aircraft in or over the British Islands and in or over the territorial waters abutting on the coast thereof; and

(2) For the reference to British ships whilst on the high seas there shall be substituted a reference to British aircraft outside the British Islands and the territorial waters abutting on the coast thereof; and

(3) For the reference to a foreign ship in territorial waters there shall be substituted a reference to a foreign aircraft whilst in or over the British Islands or the territorial waters abutting on the coast thereof; and

(4) Subsection (5) of section one of the principal Act as amended by this Act shall not apply.

7.—(1) The provisions of the principal Act as amended by this Act shall apply to any visual or sound signalling station used or intended to be used for the purpose of communication from the British Islands with ships at sea as they apply to wireless telegraphy stations.

(2) For the purposes of this section "visual or sound signalling station" includes any permanent or fixed apparatus for the purpose of visual or sound signalling, and the provisions of the principal Act and this Act shall apply to the maintenance of any visual or sound signalling station in existence at the time of the passing of this Act as they apply to the establishment of a visual or sound signalling station.

Provided that nothing in the principal Act or this Act shall apply to visual or sound signalling stations or apparatus on ships or aricraft, or to any signal station established by Lloyd's under the powers conferred by the Lloyd's Signalling Stations Act, 1888, or to signalling stations and lighthouses under the control of the Board of Trade or of any General or Local Lighthouse Authority.

8.—If at any time in the opinion of a Secretary of State an emergency has arisen in which it is expedient for the public service that His Majesty's Government should have control over the transmission and reception of messages by wireless telegraphy or visual or sound signalling, and notice to that effect is published in the Gazette, it shall be lawful for the Postmaster-General during the continuance of the emergency to make such rules as appear necessary with respect to the possession, sale, purchase, construction, and use of apparatus for wireless telegraphy or visual or sound signalling, or component parts of such apparatus, and to impose penalties and forfeitures in respect of any breach of the rules, and make such further provision as appears necessary for the enforcement of the rules:

Provided that—

(a) rules under this section shall not provide for the imposition of a term of imprisonment exceeding six months, or a fine exceeding one hundred pounds, or, in the case of a continuing offence, ten pounds for each day during which the offence continues; and

(b) any rules made under this section shall be laid as soon as may be before both Houses of Parliament.

9.—The principal Act as amended by this Act shall not extend to British ships or British aircraft registered outside the British Islands, except that any such ships or aircraft shall, whilst in or over the British Islands or the territorial waters abutting on the coast thereof, be subject to the provisions of the principal Act as so amended with respect to foreign ships and aircraft in like circumstances.

Provided that if after the establishment of the Irish Free State the legislature thereof makes other provision with respect to ships and aircraft registered in the Irish Free State and with respect to ships and aircraft when in or over the Irish Free State, or the territorial waters abutting on the coast thereof, the foregoing provisions of this section shall have effect as if the expression "British Islands" did not include the Irish Free State, and the principal Act as amended by this Act shall cease to apply to foreign ships and aircraft when in or over the Irish Free State or the territorial waters abutting on the coast thereof.

10.—(1) This Act may be cited as the Wireless Telegraphy and Signalling Act, 1922, and shall be construed as one with the principal Act, and the principal Act and this Act may be cited together as the Wireless Telegraphy and Signalling Acts, 1904 and 1922.

(2) Any reference in this Act to the principal Act or any provision thereof shall, unless the contrary intention appears, be construed as a reference to that Act or provision as amended by this Act.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, The Wireless World and Radio Review, 12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"EARTH" (London)** *asks* (1) *For the capacities of condensers C.1, C.2 and C.3, and the maximum capacity of the A.T.C. in a certain set described in the June issue.* (2) *Maximum and minimum wavelength of the same set.*

(1) Insufficient data is given for calculation, but suitable values would be — A.T.C., 0·0005 mfd. ; C.1, 0·0002 mfd. ; C.2, 0·002 mfd. ; and C.3, 0·0003 mfd. (2) Suitable for all wavelengths up to say, 10,000 metres with appropriate coils, but insensitive below 1,000 unless the A.T.C. is used in series.

**"E.H.C." (Ardingly College)** *encloses a diagram of set and asks* (1) *For windings of basket coils if suitable.* (2) *Capacities of C.1 and C.3.—* (3) *Will a home-made telephone transformer be efficient.* (4) *Would flash-lamp batteries do for B.1 and B.2.*

The set shown is of very poor type. The crystal is useless in an L.F. circuit as shown. The grid circuit of the valve is untuned, and the reaction coil couples into the aerial circuit (see Fig. 5, page 124, April 22nd issue), but with an aerial circuit loose coupling into the lower end of the closed circuit inductance. (1) Basket coils may be used, their size depending on the wavelength required, which you do not state. (2) A closed circuit condenser 0·0005 mfds., grid condenser, ·0002 mfd., anode circuit condenser, 0·0005 mfd. series A.T.C. if used, 0·001 mfd. (3) Yes, if, a sound design and carefully made. (4) Yes, but they must be switched off when not in use.

**"J.A.B." (Bayswater)** *encloses diagram of set and asks* (1) *If the circuit sketched is suitable for telephony.* (2) *If it would work with a frame aerial.* (3) *Particulars of a suitable aerial.* (1) O.K. if a leak is supplied for the second valve. (2) Yes, but it would not be very sensitive. (3) Frame 4 ft. square, wound with 40 turns No. 18, spaced ¼" and tapped at 3, 6 and 15 turns.

**"RADIO 3 UC" (Nottingham)** *asks* (1) *If values given for four condensers are suitable, and what should be the number of foils, with size, in each case, using 0·002 mica.* (2) *The maximum capacity of a certain variable condenser, and dimensions and number of foils for a fixed condenser of same capacity.*

(1) and (2) We think it would be far more profitable to you to work these out for yourself, and will therefore quote the formula.

$$C \quad \text{mfds.} = \frac{1}{900{,}000} \times \frac{Kan}{4\pi d}$$

$K$ = specific inductive capacity of di-electric, say 8 for mica and 1 for air.
$a$ = area in sq. cms. of overlap of foils.
$n$ = number of sheets of dielectric.
$\pi$ = 3·14.
$d$ = thickness of dielectric in cms.

We add calculations for your 0·001 mfd. condenser as an example :—

0·001 = 1/1,000. Mica = 0·002" = 1/200 cms. Assume an overlap of 3 sq. cms., which is a convenient figure, then formula gives :—

$$\frac{1}{1{,}000} = \frac{1}{900{,}000} \times \frac{8 \times 3 \times n}{12{\cdot}4 \times \frac{1}{200}}$$

$$1 = \frac{48n}{9 \times 12{\cdot}4}\, n = \frac{1{,}116}{48} = 23.$$

**"———" (Southend-on-Sea)** *asks* (1) *For a circuit for use with certain apparatus.* (2) *Details of plates for condenser.*

(1) See diagram page 465, Fig. 1, issue for July 8th. Filament resistance 5 ohms., other dimensions as usually given. (2) Assuming 1/8" is the distance between the neighbouring fixed plates, 16 fixed and 15 moving will be sufficient.

**"B.C." (Seven Kings)** *sends a sketch of a circuit and asks if it will receive the London broadcasting.*

Except for the leads shown short circuiting the telephones, which is probably a clerical error, the circuit is correct and should give the desired results, but a series A.T.C. of about 0·0002 mfds. would be an improvement.

**"E.W." (Hornsea)** *asks* (1) *If it is necessary to have a reaction coil with a certain tuner.* (2) *Particulars of how to connect the reaction coil.* (3) *Diagram of a one-valve set for use with a tuner.*

(1) A reaction coil is not necessary, but skilfully used would considerably increase the range of the set. Unskilfully used it might lead to serious re-radiation. (2) The coils might be 3" × 5" of No. 32, connected in the anode circuit and coupling into the end of the secondary of the loose coupler remote from the primary. (3) See Fig. 1, p. 465, issue for July 8th, for a simplified theoretical diagram of the circuit.

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**"L.R.C." (Cheshire)** *encloses a diagram of his set and asks* (1) *If a variable H.F. transformer is more efficient than a plug-in.* (2) *Could he get* **2MT** *telephony.* (3) *Is it safe to use a six-volt accumulator on "Ora" valves.* (4) *Any suggested improvements to his circuit to receive telephony.*

(1) No, we prefer the plug-in type as a rule. (2) For some reason, at present unknown, Cheshire appears a bad district for **2MT.** Except for this, you should get results. (3) Only with the use of some series resistance. (4) Set is O.K. as it stands except that a condenser is required across the primary of the L.F. inter-valve transformer.

**"G.W.C." (New Southgate)** *asks two questions about engraving ebonite, and* (3) *For an inexpensive book on the construction of sets.* (4) *Times and wavelength of* **FL** *Sunday telephony.*

(1) and (2) This is generally done on engraving machines, which are very expensive machine tools. You might be able to devise a substitute by means of a flexibly driven drill chuck guided by a suitable pantograph. Filling is effected with a special white wax, resembling in composition sealing wax. (3) "Radio Experimenters' Handbook," by P. R. Coursey (3s. 6d.); "How to Make Commercial Type Radio Apparatus," by M. B. Sleeper, obtainable from Wireless Press.

**"S.F.H." (Barnes)** *asks* (1) *What is the highest wavelength that can be received by a crystal set.* (2) *How many loose coupled tuners will be required from zero to this wavelength.* (3) *What gauge of enamelled wire is needed from the primary and secondary of the coils.* (4) *Could more than one slider be used on the primary.*

(1) Any wavelength could be received if suitable transmitting sets were in use, but at present there is no spark transmission over about 3,500 metres. (2) It is impossible to make a tuner to tune down to zero wavelength. 100 metres is a common minimum. We suggest the use of the coils you mention wound with No. 22 and No. 26, and another pair 6" × 4" wound with No. 22, and 5" × 3" wound with No. 26 for short wave work. (3) Primaries with sliders, secondaries with 12 taps each, the distance between the taps being approximately proportional to the number of turns of wire in the circuit at each tap. (4) More than one is unnecessary.

**"F.H." (Romford)** *asks* (1) *If H.F. plug-in transformers must be mounted on ebonite.* (2) *Whether* 0·001 *mfd. A.T.C. is better than* 0·0015 *for general work.*

(1) Ebonite is about the best material, but presspahn, paxoline, micanite, bakelite and various similar insulating materials may be used if desired. (2) Somewhat preferable, but very little in it.

**"C.W." (Wimbledon Park)** *asks for advice in purchasing a receiving set on which he can hear the English broadcasting stations, Eiffel Tower and the Hague Concerts, also* (1) *Minimum length for aerial.* (2) *Approximate cost of set.* (3) *If he would save money by assembling the set himself.* (4) *What apparatus to obtain.*

(1) Aerial suggested would do quite well if of sufficient height above the ground or buildings—say not less than 20'. (2) If you wish to hear all the English broadcasting stations satisfactorily the price would probably come out at nearly £100, but very useful results, including **PCGG** and **FL**, could be obtained with a set costing about £25. (3) Yes, provided you have some aptitude for work of this nature. (4) Many circuits are possible, but we recommend that you look through the diagrams given in these columns and pick out a three-valve or two-valve and crystal set with dimensions for the parts quoted.

**"J.G.N." (Tonbridge)** *asks* (1) *Why no signals are received above* 600 *metres when the set receives* **2MT** *and* 600 *metre spark signals quite well.* (2) *Approximate maximum and minimum wavelengths using two methods.* (3) *If the method shown is a satisfactory way of adding a L.F. valve to existing set.* (4) *If an "Ora" valve will work in conjunction with "R" valves, having* 45 *volts on the plate and using the "Ora" as L.F.*

(1) Set should be O.K. but there is little to be heard above 600 metres until you get up to about 2,600 metres, except air stations, which you should be able to get. (2) (*a*) About 1,500 metres. (*b*) Approximately the same. **PCGG** should probably be received with series condenser and about half the coil, but difficult to predict exactly. (3) Yes, quite O.K. (4) Yes.

**"J.McV" (Belfast)** *has a two-valve resistance capacity coupled set with reaction and asks* (1) *If a four-valve L.F. amplifier is added could he receive Dutch Concerts.* (2) *How to make the set more suitable for receiving short wavelengths.* (3) *If a range of* 300/30,000 *metres is possible in view of the coupling employed.*

(1) Doubtful. We should prefer more H.F., but in any case do not think your prospects of good results very great. (2) Suitable transformer coupling for resistance capacity. (3) Yes.

**"A.S." (Stockport)** *encloses diagram of his single valve set and asks* (1) *If a two-valve L.F. amplifier added to a panel would be the best three-valve combination.* (2) *If so, how to add amplifier with least disturbance of panel connections.* (3) *How to make a L.F. transformer for same.* (4) *If No.* 32 *S.S.C. wire would do for making the above.*

(1) Possible, but it would be better to add one valve as H.F. amplifier and one as L.F., diagram becoming similar to Fig. 3, page 340, issue for June 10th. (2) For your suggestion connect filaments in parallel on the same supply, put transformer in place of telephones, and bring anode circuit of each valve back to the positive of the H.T. battery. (3) Core ½" × 4" of iron wires, winding 1 oz. and 3 oz. of No. 44. (4) No.

**"P.P." (Liverpool)** *asks* (1) *If the ends of an inductance coil should be connected directly to the first valve of a circuit.* (2) *What relation should the inductance of the secondary bear to the inductance of aerial circuit.* (3) *How is the value of the reactor related to the number of turns in the primary or secondary coils.*

(1) Coupling through a secondary inductance is better as it gives better selectivity. (2) The inductance of a secondary should be such as to tune to any required wavelength with a parallel condenser of capacity not greater than 0·0005 mfds. (3) There is no fixed relation, the value depending on constants of the valve, etc. For most circuits a value somewhat smaller than that of the coil with which it couples is desirable except on very small wavelengths, when rather more is required.

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**"S.C." (Beckenham)** *is constructing a three-valve receiver, and asks* (1) *Dimensions of coils and number of tappings for an aerial inductance tuning from* 200 *to* 3,000 *metres* (2) *Dimensions of reaction coil to rotate in the aerial primary.* (3) *Dimensions of aerial inductance for tuning from* 3,000 *to* 30,000 *metres, and* (4) *A reaction coil,* 3,000 *to* 30,000 *metres.*

Size of the inductance depends upon the dimensions and design of your aerial. If of the two-wire type, and of the maximum dimensions laid down by the P.M.G., you should use a coil 6" in diameter, with 5" of winding of No. 28 D.C.C. wire. The winding should be tapped out on to a switch having 15 to 20 studs, the long wave tappings stepping off further distances along the coil than those for short wave. Such a coil will not efficiently tune to such low wavelengths as 200 metres, and you would be well advised to construct a special inductance for short wave reception. This may consist of 1" of winding of No. 24 D.C.C. on a 4" former. (2) Former 3½" in diameter, having 1½" of winding of No. 34 S.S.C. with about 10 tappings at increasing distances along the turns. For short wave work a sliding coil should be used, closely fitting inside the aerial coil, and being of approximately equivalent inductance. (3) These windings must be found by experiment, and you would do well to build up inductances of the type shown on page 328 of June 10th issue, assembling a large number in series with insulated paper between, and making sure that they are connected up so that there is no reversal in the direction of winding. They should be held securely in position, as any fluctuation in the distance between the coils materially alters the inductance value. (4) The reaction inductance may be similarly constructed, and for the purpose of providing coupling between the two inductances, one coil of each should be brought out and so arranged that their relative positions may be varied.

**"S.F.H." (Barnes)** *asks* (1) *What is the highest wavelength.* (2) *How many loose coupled tuners with primary* 6" · 12" *will be required to tune to the highest wavelength.* (3) *What gauge of wire is required for the primary, and whether more than one is required.* (4) *Gauge of wire for secondary and number of tappings.*

(1) Wavelengths of 23,000 metres are at present used, and the tendency may be to increase this. (2), (3) and (4) We presume you mean to connect your tuners in series with one another, which is not a very satisfactory arrangement. The amount of wire depends upon the size of the aerial, and for one wave you are advised to make use of specially wound coils of the basket, slab, honeycomb, or other well-known type. When using a receiving circuit embodying reaction, resistance in the aerial circuit is, within certain limits, of little consequence, as any jamming that may be produced is compensated for by tightening the reaction coupling. No. 28 D.C.C. is suitable for aerial circuit, and No. 32 D.C.C. for reaction coil.

**"G.D.G.T." (Oundle)** *asks two questions about a four-valve circuit.*

We prefer two H.F., one detector and one L.F. valve, which should give quite good results on a 6-ft. frame aerial.

**"W.C.P." (Watford)** *asks for help with his set which gives very distorted speech.*

The arrangement of the set is quite correct and we are not clear why you are getting distortion. It may be due to one or two causes, namely poor design of the L.F. intervalve transformer or your allowing the set to oscillate. You might try a grid potentiometer to the first valve, and weaker reactance coupling.

**"C.C.B." (Sheffield)** *asks* (1) *For windings of a reaction coil suitable for use with a loose coupler.* (2) *For capacities of condensers.* (3) *Wavelength range of his set.* (4) *Ratio between A.T.I. and reaction when honeycomb coils are used.*

(1) Coil might be 5½" × 4" of No. 26. (2) 0·001 for the aerial circuit, 0·0005 for the closed circuit. (3) About 3,500 metres. (4) There is no definite best ratio but, except for very short wavelengths, the reaction coil can generally be somewhat smaller than the A.T.I.

**"DYNAMO" (Clapham Junction)** *asks for advice on the erection of an aerial.*

Your situation appears somewhat unfavourable and you do not give us much idea as to the possibilities. Fairly useful results might be obtained by fixing a mast in the top of the tree and running a lead from the receiving room up towards the eaves above it, but not too close to the wall, and from thence to the mast in the tree. A better alternative, if possible, would be to run an aerial up to the same point near the eaves and thence to the house 60' away. We are afraid your range with a single valve set would be somewhat limited.

**"H.C.S." (Kirkby Stephen)** *asks* (1) *If a transformer sketched will do for amplification of telephony on* 300 *to* 600 *metres.* (2) *If a H.F. transformer sketched would be more efficient if two sections were used as primary with switch for the other six.* (3) *Where to obtain particulars for the construction of H.F. and L.F. intervalve transformers in order to make them in quantities.*

(1) If properly made this should give useful results. (2) The suggested scheme would probably be satisfactory, but experimental test would be necessary to determine the best wavelength for each one of the sections. (3) These columns are intended for the assistance of amateurs in difficulties and not for the guidance of persons desiring to undertake quantity production—presumably for commercial purposes.

**"A.R.B." (New Barking)** *asks* (1) *For a diagram of three and seven-valve circuits with details of construction.* (2) *If a circuit with one valve as H.F. amplifier, one as rectifier and one as L.F. amplifier needs transformer coupler.*

(1) For a three-valve circuit see Fig. 2, page 304, issue for June 3rd. For six-valve circuit see Fig. 1, page 368, issue for June 17th, to which an additional H.F. or L.F. valve can be added if desired. We have not space to give full design details for these sets, but typical values for each component have been frequently quoted. Details of a valve set, were given in issues 16 to 22 of Vol. 8. (2) Transformer coupling is probably the best for all-round purposes, but needs a series of transformers to cover a big range. A resistance capacity coupling is good for all wavelengths above 1,000 metres, but very poor below this figure.

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**"E.A.A." (West Ham)** *gives particulars of his set, from which he gets no results, and asks why.*

The set appears fairly correct and should give results. It would be better, however, to connect one end of the coil to earth and one side of the condenser, and one slider to the aerial and the other slider to the other side of the condenser. Try reversing the polarity of the potentiometer battery. No. 30 is rather thin for the A.T.I. Possibly the crystal is defective. (The resistance of carborundum is far too high for you to light the lamp through it.)

**"T.B.R." (Newcastle)** *asks questions about Marconi high speed services.*

A certain amount of fairly high speed work is done by the transatlantic stations, with speeds up to 50 to 60 words per minute; times irregular, depending on traffic requirements and reception conditions. The London-Paris medium power service is nearly all high speed, varying from 70 to 130 words per minute, according to traffic requirements. The service is at all hours of the day and night, but generally slack during the night. No call letters are used, but stations are in constant communication. The wavelengths used are 3,800 metres for the English station, and 2,300 for the French.

**"J.B.B." (Cambridge)** *asks* (1) *Particulars of a certain loose coupler.* (2) *Gauge of wire to be used.* (3) *Under what wavelength are resistance capacity coupled H.F. amplifiers inefficient.*

(1) and (2) Primary 6" × 4" of No. 22, tapped at 1½", 2½" and 4". Reaction 4" × 6" of No. 26, with tappings at 2" and 3". (3) About 1,000 metres.

**"K.W." (Sidcup)** *asks* (1) *The best type of coil to use to receive wavelengths from* 100 *to* 25,000 *metres.* (2) *Sizes of the coils and gauges of wires.*

(1) and (2) To cover such a range of wavelengths it would be best to use a series of honeycomb coils, with the number of turns ranging from about 40 to 1,500. These coils are generally wound with about No. 26 or 28, and can be bought from various dealers.

**"EXPERIMENTER" (Folkestone)** *asks with regard to a diagram for a three-valve amplifier on page* 340 *of June* 10*th issue* (1) *Would not a potentiometer control for the third and fourth grids be an advantage.* (2) *Would the use of a* 0·002 *mfd. condenser across the primary of a H.F. transformer improve the set.* (3) *For short wavelengths, would results be improved by using a loose coupled tuner with reaction.*

(1) For first and second grids it would be an improvement; not necessary for the third. (2) Yes, but the value is rather high. (3) This would give greater selectivity on all wavelengths.

**"K.H." (Delhi)** *encloses a diagram of his set and asks* (1) *If the circuit is correct.* (2) *If further similar H.F. and L.F. amplifier units can be attached.* (3) *If the grid potentiometer X on the H.F. amplifier is desirable.* (4) *Should the blocking condenser Y on the rectifier be variable or fixed.*

(1) Quite good. (2) Yes. (3) Yes, unless condenser rectification is employed. (4) Fixed will do. About 0·001 mfds.

**"C.H.W." (Capetown)** *asks* (1) *If a circuit sketched is correct.* (2) *If he could use certain transformer cores for intervalve transformers, with details of winding.*

(1) Diagram is correct except that the reaction coil should be on the valve side of the iron-cored winding, but should have a 0·001 mfd. condenser across it. (2) Yes. Wind full with two coils of No. 44, the secondary having approximately twice as many turns as the primary.

**"H.W.K." (Peckham)** *asks* (1) *Gauge and insulation of three samples of wire enclosed.* (2) *If* 130 *ohm telephones could be used.* (3) *If he would get results from a* 30′ *aerial running parallel with a tram and electric railway system.*

(1) No. 1 = No. 37. No. 2 = No. 37. No. 3 = No. 32. (2) It should be O.K. (3) You may have rather troublesome induction effects.

**"A.F.R." (Boscombe)** *has made up a Reinhardt tuner, described in May* 13*th last, and wishes to know if he can add a five-valve magnifier, a circuit diagram of which he submits, and comprising two H.F. valves, one detector, and two L.F.*

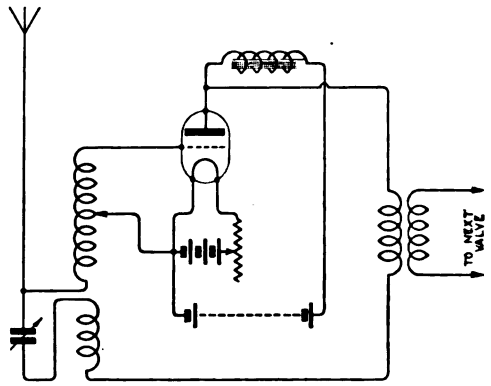


*Fig.* 1.

You cannot conveniently add your amplifier to this receiver and work with common H.T. and L.T. batteries, unless you care to make use of a choke coil at the point of distribution of the H.T. For circuit diagram see Fig. 1.

**"HOPEFUL" (Brixton)** *asks* (1) *If a diagram is correct.* (2) *If any additional condensers are necessary and their capacity.* (3) *If the set would receive the Dutch concerts.*

(1) and (2) Correct, except that the grid potentiometer shown to the first valve must be omitted from this set, and a condenser of say 0·001 mfd. should be in circuit across the primary of the first intervalve transformer. (3) Yes.

**"CONSTANT READER" (West Kensington)** *asks certain questions about H.F. transformers.*

The method of winding you suggest is not very good as it involves considerable risk of breakdown between the coils. There is no formula for calculating the wave range of such transformers, as this depends on the self and mutual capacity of the coils which it is impossible to predict. The wavelengths of the transformers you mention might come out about 500 metres, 800 and 1,200 metres, but it is quite possible that the values may vary very considerably from this.

**"ZETHERDOWN" (Mill Hill)** *asks* (1) *What stations he could receive with a crystal receiver using an aerial* 40/45′ *high and* 60′ *long, twin wire.* (2) *The name of the Wireless Society covering the Mill Hill district.* (3) *A list of the instruments*

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*necessary to construct a simple and efficient crystal set.* (4) *Details of the station near Hendon Aerodrome.*

(1) Ships, broadcasting and other shore telephony in London, air stations and stations such as Eiffel. (2) Wireless Society of Highgate, Highgate Literary and Scientific Institute, South Grove, Highgate. (3) Aerial, earth connection, loose coupler with slider tuning of primary, variable condenser, perikon or similar crystal, pair of H.R. telephones. (4) If you mean the Marconi Company's research station, we regret that the only information we have is that published on page 219, May 20th issue.

**"AMATEUR" (Shepherd's Bush)** *asks four questions about a set of which he gives a diagram.*

(1) We do not understand your circuit, as you speak of a loose coupler and show a single coil. Also, your data for coupler are very vague. The

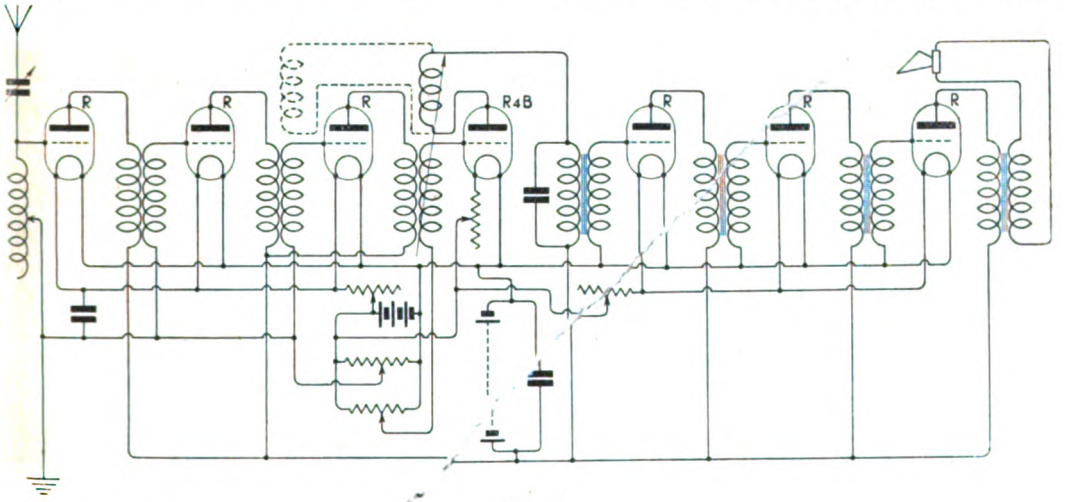


*Fig. 2*

circuit might possibly tune up to 1,500 metres. (2) The circuit is fairly good as shown except that a parallel A.T. condenser should not be used on short waves. (3) London broadcasting and many amateurs in London district, and air stations near London. (4) Very few additional stations would come into your range unless you also introduced reaction, although all stations would be increased in strength.

**"E.R.W." (E.9)** *asks for circuit diagram of receiver suitable for the reception of short wave telephony, and capable of operating a loud speaker.*

We would advise you to use three H.F. amplifiers and efficient rectifier, and three note magnifiers. The only difficulty in making up such a set is the design of the H.F. transformers. These must all be identical in value, for should one have a slightly different optimum wavelength, it will filter out signals on which the other two would be capable of giving good amplification. These transformers should be wound on 1" ebonite rod, the primaries and secondaries being wound in the same direction, insulated from one another by a single layer of empire cloth, and consisting of 300 turns of No. 38 S.S.C. The finishing ends should be taken to the grids and plates. For circuit, see Fig. 2.

**"C.W.A." (Wandsworth Common)** *wishes to make use of alternating current supply at 50 periods 205 volts for the purpose of supplying the high tension current at 400 volts required by his small power telephony transmitter, and asks* (1) *For diagram of connections.* (2) *Size and type of transformer to be used.* (3) *Details of chokes and condensers.* (4) *Details as to power consumption for the purpose of working his transmitting valve on 10 watts.*

(1) See diagram Fig. 3. (2) The transformer should be of the closed core type, the core of which may be made either of soft iron strip or wire. That part of the core which passes through the windings should have a cross sectional area of not less than three square cms. and 2¾" long. The primary should be wound with No. 22 double cotton covered wire and consist of five layers. The secondary should be wound with No. 28 D.C.C wire up to a diameter of 2". The secondary would best be wound in 11 flat sections. A separate choke coil should be made up and connected in series with the primary winding for the purpose of still further reducing the current taken from the mains, and also for adjusting the power factor. (3) The two choke coils shown should be wound on iron wire cores, 6" long by ½" in diameter, with No. 32 S.S.C. wire, up to a diameter of 1½". A piece of thin insulating paper should be placed between each layer. The condensers should have the values shown and be capable of withstanding 1,000 volts, *i.e.*, mica insulation of not less than 0·002" should be used for building them up. (4) You would find it very convenient to connect a milliammeter with a maximum reading of 25 in the negative lead. If your oscillation circuit is so connected that the H.T. plus is above earth potential, the accumulator which heats the filaments must be well insulated. You will be well advised to use special rectifying valves instead of the ordinary "R" type. Alternatively connect two valves in parallel on either side of the transformer.

**"A.E.F." (Fleetwood)** *asks* (1) *What languages the press and weather transmissions from Bucarest, Budapesth, Prague, Sarajevo and Nikolaiev are in.*

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(2) *Where it is possible to obtain the Berne international list of wireless stations and regulations.* (3) *Where to obtain a diagram of the Marconi multiple tuner.* (4) *If it could be used with a valve for ship stations.*

(1) French is usually employed. (2) Bureau International de T.S.F., Berne. (3) See diagram

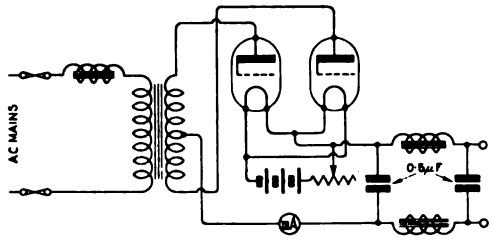


*Fig.* 3.

Fig. 4, which is simplified by the omission of the switching arrangements. (4) Not suitable for use in this way, as it was designed for use with a magnetic detector, which has a low resistance. We should recommend dismantling, and re-arranging the parts to form a modern tuner.

"**E.A.D.**" **(Wooler)** *has a three-valve which does not give very satisfactory results. He describes the components, and wishes to know the probable cause of his trouble.*

In the circuit you submit you have connected small condensers in series with the grids of all valves. This should not be done. The grid condenser and leak should only be connected to the last H.F. valve, that is the one which is to rectify. It is very important that a condenser having a value of about 0·001 mfds. should be connected across the telephone receivers as a by-pass for H.F. current that is to pass to the reaction coil. The reaction coil is incorrectly connected, and should be arranged as shown in the diagram given to "**J.W.B.**" **(Northfield)**. We would recommend you to procure a low frequency intervalve transformer, in order that the last valve may be connected as a note

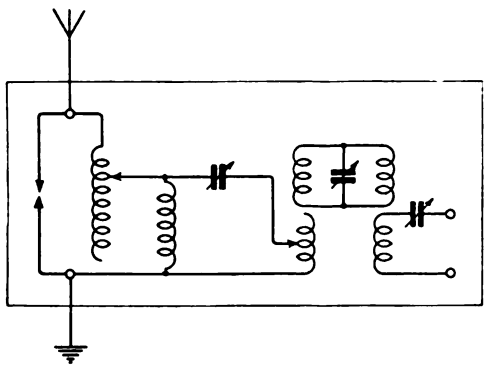

*Fig.* 4.

magnifier, as it is very difficult to make two intervalve oscillation transformers of identical value, and moreover, a low frequency amplifier will give greater amplification. For the reception of short wave telephony, you should, of course, connect your aerial tuning condenser in series with the inductance, and you may find it convenient also to bridge the reaction coil with a small variable condenser, having a maximum value of about 0·0004 mfds. The diagram referred to gives the amended circuit diagram, and in addition, shows how you may make up additional amplification circuits. From your sketch it is difficult to say the best method for connecting in the H.F. transformer, as we are unacquainted with the direction of winding. If the windings are in the same direction, the inner ends of primary and secondary should be taken to grid and plate, and if in opposite directions, the two ends that come out between primary and secondary winding, should be the grid and plate.

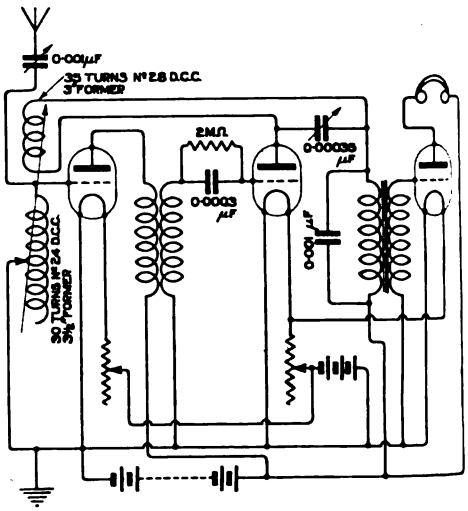


*Fig.* 5.

"**J.W.B.**" **(Northfield)** *gives particulars of his tuning coils and asks* (1) *What wavelengths they will tune.* (2) *For a circuit diagram of three-valve receiver suitable for the reception of telephony.*

(1) It is impossible to advise you as to the wavelength range of your coils as it materially depends upon the dimensions of your aerial. The approximate range on a two-wire aerial of maximum dimensions would be 2,700/1,700 metres. (2) For circuit, making use of the apparatus you have, see Fig. 5.

## SHARE MARKET REPORT

Prices as we go to press on July 31st, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 5 | 0 |
| ,, Preference .. .. | 2 | 1 | 3 |
| ,, Inter. Marine .. .. | 1 | 6 | 1½ |
| ,, Canadian .. .. | | 10 | 6 |

Radio Corporation of America:—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | 1 | 0 | 7½ |
| Preference .. .. .. | | 13 | 6 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
VOL. X. No. 20. AUGUST 12TH, 1922. WEEKLY

## Wireless and Meteorology

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

THERE are many classes of the community to whom the weather conditions are of the utmost importance. The aviator, the sailor, the farmer, the holiday-maker and motorist are all interested in the weather, though in very different ways. For whereas some of these are chiefly interested in present weather conditions over a large *area*, others are more naturally concerned with future weather conditions spread over a considerable period of *time* (*i.e.*, in weather forecasts). Yet again, for each of the classes mentioned there are problems of very special concern. The aviator is more naturally interested in the strength and direction of the wind and the visibility and amount of cloud in the atmosphere above the ground. This is specially so in the cross-channel flights (see Fig. 1). The farmer, on the other hand, naturally seeks information of future weather, likely rainfall and sunshine. It will thus be apparent that any organisation which attempts the dissemination of meteorological data must be far-reaching both in regard to the area covered and the diversity of the elements recorded and transmitted. But in any case there must be included a great deal of information which does not interest individual members of the community. This difficulty has to some extent been overcome in France by the issue of a special "Agricultural meteor" at 0710 G.M.T. daily, intended for farmers. For this purpose France is divided into several regions and a forecast for the next 24 hours for each district is sent in plain language by telephony.

During the war, the demand for early meteorological information became very acute, and although codes for use in weather telegraphy had been devised as far back as 1875, they were not sufficiently comprehensive for the more immediate needs of war. The impetus given by the war has no doubt brought about a more general interest in meteorology, and the immense amount of data now dealt with requires the use of a code for the sake of brevity.

In the organisation of a meteorological service three problems are involved, namely, the collection, exchange and distribution of reports. The following brief outline deals with the services undertaken in this country :—

(i) The collection of observations of present weather from a number of stations embracing the British Isles and the surrounding regions. Nearly 60 stations are now included in this network and report daily to the Meteorological Office at the Air Ministry. In this country reports are collected by W/T from about ten stations, and the remaining reports are collected by telegram and in certain cases by telephone. The reporting stations are of different kinds :—

(*a*) A first-order land station or normal Meteorological Observatory is one at which *continuous* records or hourly readings of the following elements are taken: air pressure, temperature, wind, sunshine and rain, with eye observations at fixed hours of the amount, form and motion of clouds, together with notes on the weather.

(*b*) Second-order stations: observations are recorded daily at two fixed hours at least of pressure, temperature (wet and dry bulb), wind, cloud and weather, with daily maxima and minima of temperature, daily rainfall and general remarks on the weather. In some cases the duration of bright sunshine is added.

(*c*) Third-order or auxiliary stations are

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of the same kind as (*b*), but report either (i) less full or (ii) observations taken once a day only, or (iii) observations taken at other than the recognised reporting hours.

Besides reports from these 60 stations, the Meteorological Office exchanges reports with nearly all the principal meteorological observatories in Europe. Reports from ships on the Atlantic are also received by W/T and are often of great value to the professional meteorologist at headquarters when making a forecast. They are often indicative of impending changes on the western seaboard, and their value will be referred to later.

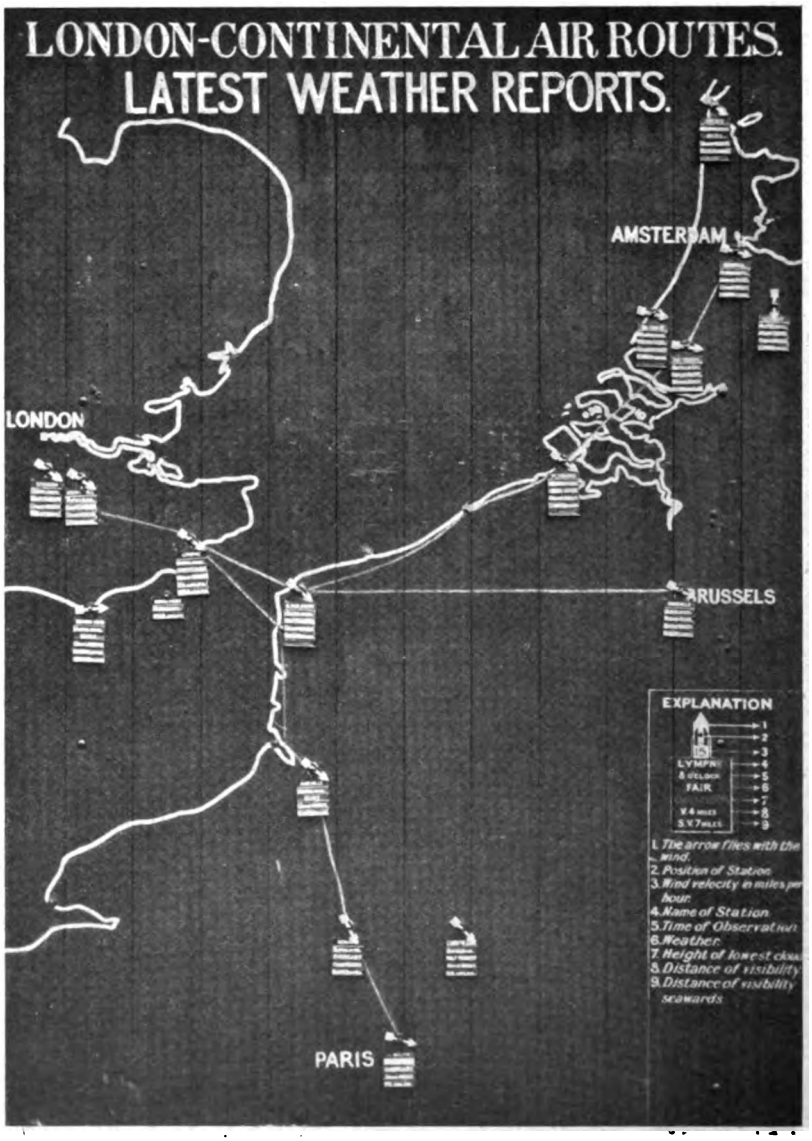


*Fig. 1. Weather chart for the guidance of pilots at the London Terminal Aerodrome. The chart gives in a graphical form, information of great value to the airman. Wind, weather, cloud and visibility observations along the route are shown by means of the arrows and indicators which are frequently "set" by the meteorological staff at the Aerodrome from reports received by W/T.*

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The central Meteorological Office translates the individual reports into a graphical form by entering the chief elements on a map. These maps, or *synoptic charts*, give a general impression of the present weather at a certain instant of time over a very large area (compared with the area covered by individual reports). They are the basis of modern forecasting. The trained meteorologist thinks in maps.

The most general thing which could be said about the weather is that it is constantly changing, or perhaps more precisely, it is constantly subject to change. It is consequently necessary to devise means for rapidly

*Fig. 2. Croydon Aerodrome Meteorological Station. "Atmospheric" D.F. Apparatus, or "Thunderstorm Finder"—an auxiliary investigation carried out in the field of meteorology by means of wireless.*

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making known in a comprehensive form the various changes which are going on in the atmosphere. As we have indicated, before the war there was no national distribution, although some headway had been made by the publication of charts and forecasts in the daily newspapers. Information through these channels was of necessity several hours old. W/T furnishes a means of rapidly broadcasting this information.

The distribution now carried out by W/T from the Meteorological Office comprises three distinct forms of report.

(α) The "general inference" which is issued in plain language (Morse code) at 0915 and 2000 G.M.T., and of which the following is a specimen: Saturday, July 29, 1922. "General inference from observations at 7 p.m. (18 h.):—A secondary depression has developed off South-west Ireland and will probably move north-eastward, causing rain in the west and north. Over the midland, southern and eastern districts the weather is likely to continue mainly fair with moderately high temperature." This general inference embraces the whole of the British Isles, and its very general character is evident at once. In drawing any conclusions from a *single* inference, great care must be exercised. However, if this inference is used in conjunction with a synoptic chart drawn up a few hours previously (as for example those published in several of the daily newspapers), a good general idea of the changes likely to come about in any particular area can generally be estimated. A similar forecast is issued for the "western seaboard" from Clifden, and particulars of these transmissions is given in the table below:—

(β) Coded forecasts for various districts in the British Isles are also issued. They are sent in code for the sake of brevity, but they would be of greater value if they could be sent in plain language in a similar form to the French agricultural meteor.

The districts covered are roughly as follows:—

Group 111.—Southern England (central part): Dorset, Wiltshire, Berkshire, Hampshire.

Group 222.—South-east England: London, Middlesex, Essex, Surrey, Sussex and Kent.

Group 333.—Yorkshire, Lincolnshire, Nottinghamshire.

STATIONS TRANSMITTING METEOROLOGICAL INFORMATION IN GREAT BRITAIN.

| Station. | Call Sign. | Latitude. | Longitude. | Wave-length. | Nature and Time of Transmission (G.M.T.) |
|---|---|---|---|---|---|
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 1,400 C.W. | Synoptic data for 0100 sent at 0200. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 4,100 C.W.* | Synoptic data for 0100 sent at 0600. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 4,100 C.W. | Synoptic data for 0700 sent at 0800. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 4,100 C.W. | Synoptic data for 1300 sent at 1400. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 4,100 C.W. | Synoptic data for 1800 sent at 1900. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 1,680 C.W. | Aviation reports at 0335, 0435, 0535, 0635, 0735, 0835, 0935, 1035, 1135, 1235, 1335, 1435, 1535, 1635. |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 1,300 C.W. | Coded district forecasts sent at 0900 (approx.), 1500 (approx.) and 2000 (approx.) |
| Air Ministry | GFA | 51° 31′ N. | 0° 07′ W. | 4,100 C.W. | General inferences sent at 0915 and 2000. |
| Clifden (Ireland) | MFT | 53° 27′ N. | 10° 1′ W. | 5,750 spk. | Western seaboard forecast and data issued at 0950 and 2150. |
| Croydon .. | GED | 51° 21′ N. | 0° 08′ W. | 900 C.W. | Radio-telephonic communication with aircraft in flight. |
| Lympne .. | GEG | 51° 05′ N. | 1° 01′ E. | 900 C.W. | Radio-telephonic communication with aircraft in flight. |
| Renfrew .. | GER | 55° 52′ N. | 4° 24′ W. | 900 C.W. | Radio-telephonic communication with aircraft in flight. |
| Renfrew .. | GER | 55° 52′ N. | 4° 24′ W. | 1,300 C.W. | Meteor reports to Air Ministry at 0705, 1005, 1305, 1605, 1805. |
| Lerwick .. | GEL | 60° 09′ N. | 1° 10′ W. | 900 spk. | Meteor report (Reykjavik) to Air Ministry at 1005. |

* Note.—In cases of breakdown of the main set or other delay in commencing transmission on 4,100 m. the message will be issued on 1,400 m., commencing 10 minutes after the routine time.

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Group 444.—South-east Scotland (places within a 50 mile radius of North Berwick).

Group 555.—South-west England: Devonshire and Cornwall.

Group 666.—North-west district: Lancashire, Cheshire, Shropshire and North Wales.

Group 999.—England and Southern Scotland taken collectively. The forecast for this group is appended to the "general inference" issued at 2000 G.M.T.

(7) Synoptic reports are issued in code. The information contained in these messages, when plotted on a chart, graphically describe the distribution of barometric pressure (reduced to sea level and to a temperature of 32° F. in latitude 45°), the direction and velocity of the wind, the state of the sky and/or sea and the character of the weather from simultaneous observations taken at certain fixed meteorological stations on land supplemented by information transmitted by ships. To make full use of these transmissions, the amateur requires some knowledge of the principles of meteorology. A brief explanation of the method adopted will be given in a future article.

The table on page 612 gives a complete list of regular transmissions of meteorological data in Great Britain.

The main problems involved in the application of W/T to the science of meteorology have been indicated above. There are, of course, other matters such as the electrical, optical and acoustical phenomena occurring in the atmosphere which are closely allied to to the science of meteorology. Among these auxiliary problems, W/T has been used in the location of thunderstorms. Fig. 2 shows the form of direction finding apparatus employed at the meteorological station at Croydon. A frame aerial is installed in the room above the instruments. A wavelength of 30,000 metres is used, and the number of "atmospherics" heard in different directions in 15 seconds is counted. During the war this method was extensively used by the D.F. stations of the Admiralty in locating the position of thunderstorms by determining the direction from which the radio disturbances created by a storm were received.

# Litzendraht

## Its value in the Construction of Tuning Coils.

IT is not generally realised, I think, what a great aid to efficiency is to be found in the use of Litzendraht for tuning coils. It is perhaps as well to explain here that this is a form of wire made up of a large number of fine separately insulated strands, which has the valuable property of very low high-frequency resistance (that is, when compared with a solid conductor of equivalent direct current resistance). Such wire is extremely desirable in all circuits whose damping cannot be annulled with reaction, such as the aerial circuit of a loose-coupled tuner where the reaction coil is coupled to the secondary circuit, its use giving stronger signals and sharper tuning. The objection to Litz, of course, is its cost, but this is not very heavy for short-wave coils, and it is greatly to be desired for all waves below 600 metres. It is even arguable that it should be used for circuits which are boosted with reaction, for some authorities, while agreeing that it can compensate for the flatness of tuning which results from high resistance coils, hold that reaction cannot altogether make good the loss of signal strength.

The only difficulty likely to be met with in using Litz is the matter of making connection to the ends of the coil. Soldered connections are absolutely essential, and care must be taken to see that every strand is well tinned and soldered into the joint. If the strands are enamelled and silk-covered it may be found a little difficult to bare them for tinning without damaging them. The safest way to do it is to carefully scrape off the silk and then burn off the enamel by placing the wire momentarily in a relatively cool flame, such as a match or candle. More careful scraping will then produce a clean surface to tin.

G. P. K.

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# Some Experiments with a Kite Aerial

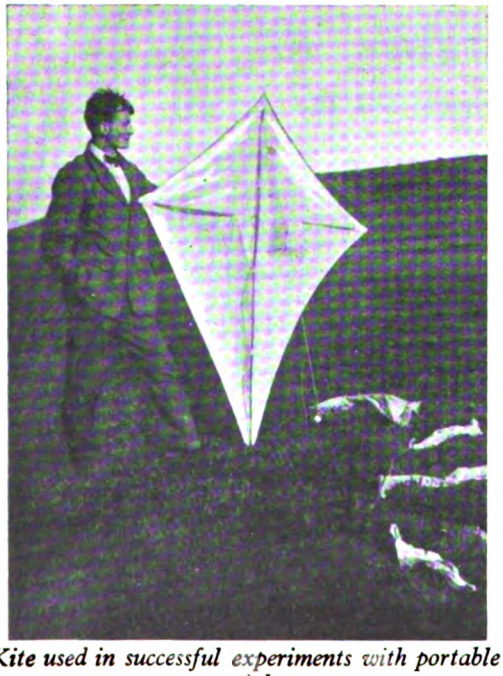
By E. S. AND J. C.

THERE will be some amateurs who are thinking about field days with a portable set now that the fine weather is here. Their thoughts may naturally turn to the possibilities of a kite aerial.

The writers give below some details of the results of several outings spent on the Yorkshire moors with a valve set and a kite aerial.

The receiver was a Mark III converted to a single valve set with a wavelength range of 160 to 20,000 metres. The accumulator and H.T. were carried in a separate box. The aerial, a kite, was constructed on the following lines, after the well-known "fin" type. The length was 6 ft. and the greatest breadth 4 ft. Two strong bamboo canes formed the sticks; light calico was used for the covering. The complete kite weighed 14 ounces. A "tail" consisting of six dusters and handkerchiefs was used. We first tried an aerial of 20 S.W.G. steel piano wire, to be on the safe side for strength and as a guide to the lifting power of the kite. In a light wind, about 10-20 m.p.h., the kite easily lifted 600 feet of this wire and remained flying very steadily. We might mention that a winch constructed out of a large sea-fishing reel was used to wind in the wire. The antenna system was completed with an earth pin, simply a 2-ft. brass rod driven into the heather and a lead soldered on.

*Kite-lifted aerial comprising 600 ft. 20 S.W.G. steel piano wire.*



*Kite used in successful experiments with portable aerial.*

We tried reception on the above aerial, inefficient as it must have been, with 600 ft. of wire out. The long wave stations, Carnarvon, Rome, Lyons, etc., came in louder than on two valves with a good P.M.G. aerial. The aerial was reeled in for 300 feet for shorter waves, a small series condenser being used. Ship stations could be read with telephones on the ground. The strength of signals on the lower waves, 300 to 450, was extremely good. **2 FQ**, both speech and music, was heard nicely until BVN chipped in and about burnt the telephones out! Local amateurs, **2 QK** especially, were very strong. On these short waves we found no fluctuation of wavelength from any swinging of the aerial.

Encouraged somewhat by the results obtained from the steel wire we tried one of copper,

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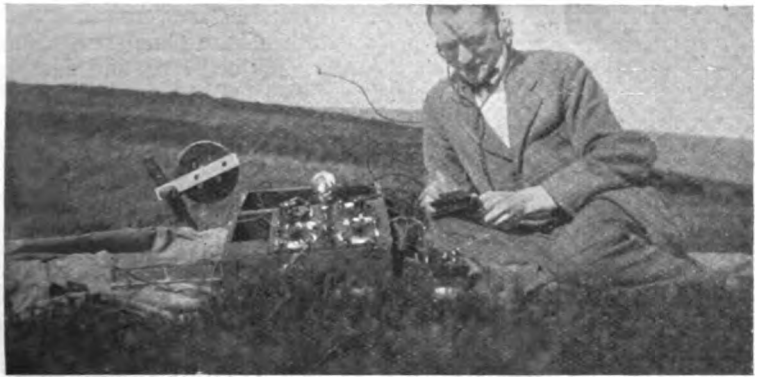
bare 20 S.W.G., using the same tackle as before. Results with this were considerably better of course and, since it was Sunday afternoon, we tested signals on the Dutch concert. This came in comfortably strong and with a stage or so of low-frequency amplification would have been readable out of a loud speaker.



*Mark III Receiver converted to single valve set with 160 to 20,000 metres range.*

Of course we had the usual interested passers-by who wanted to listen to "wireless music," and there was some competition for the spare headphones.

As a comparison with the earth pin we tried a counterpoise earth, simply a 300 ft. length of bare copper wire, 18 S.W.G., laid along the top of the dry heather directly under the aerial and connected to the earth terminal. Signals were not much stronger by this method, but it was found that the set would oscillate much more readily and enabled us to get down to a lower wavelength, using more aerial wire than before.

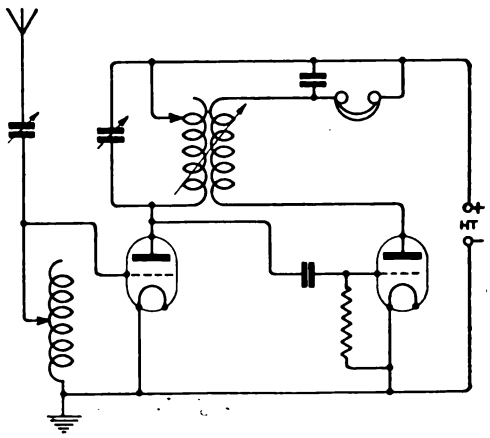
In conclusion, we would state that care should be taken in handling a long kite aerial, as quite large static charges are collected. We could easily draw small sparks by touching the aerial terminal with the finger. If a very small variable condenser, air dielectric, is used in series with the aerial, the accumulated charge of static in the aerial periodically "jumps" the plates and a continuous ticking is heard in the telephones.

Our height above sea level was about 950 feet, that is to say, for the bottom of the aerial; the direction of wind was W.N.W.

# An Anti-Radiation Circuit

THOSE amateurs who use the well-known "tuned plate circuit" method of H.F. amplification have it in their power to adopt an extremely simple device to prevent radiation from their sets when oscillating. The device, though not new, is by no means so widely known as it deserves to be. It consists in reacting into the tuned plate circuit instead of the aerial circuit, and it results (in the case of a well-arranged set, *i.e.*, one in which the various circuits are well separated) in complete freedom from radiation when the set is oscillating for the reception of C.W. or searching for carrier-waves. (It is surely unnecessary to explain that no set should ever be allowed to oscillate when receiving telephony?)

The arrangement of a typical circuit employing this device is shown in the figure. Two points which should be noted are, firstly, that the reaction coil only needs about half the number of turns which would be required to




react into the aerial circuit, and secondly, that since the damping of the aerial circuit can no longer be reduced with reaction it must be kept as low as possible by using low-resistance wire and the very best of insulation throughout.

G. P. K.

B

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# A Four-Valve Station Suitable for Short Wavelengths *(continued)*.

By PERCY W. HARRIS.

3.—THE TWO-VALVE L.F. AMPLIFIER (*continued from page* 509).

THE third unit of the four-valve set is a two-valve low frequency amplifier, fitted with a switch so that one or two stages of note magnification can be used at will. The general appearance of the unit can be gathered from the photograph, Fig. 1. The construction in detail is shown in the drawings. The circuit is of conventional design, but there are one or two details which require special mention.

In the first place, this note-magnifier unit is designed to work off the same accumulator as the previously described H.F. and detector unit, and a separate H.T. battery need not be used. It will be noticed that there are H.T. terminals on each of the two units. When both units are used together the H.T. battery should be connected to the terminals on the note-magnifying unit, those on the H.F. and detector unit being left disconnected.

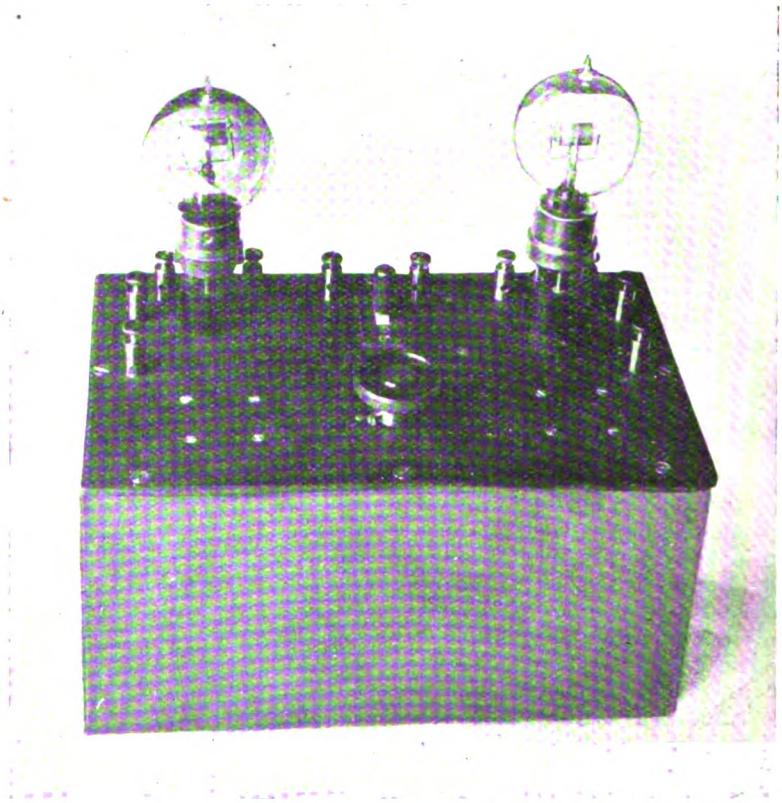

*Fig.* 1. *Photograph of the two-valve amplifier.*

The second point is the provision of

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terminals for grid cells or potentiometer. A study of the valve as an amplifier shows that, with most valves, much better results are obtained if the grid is maintained at a constant negative potential. This negative potential can be obtained either with a potentiometer connected to two or three dry cells or by placing one or two cells in the circuit of the grid. The first arrangement yields a finer adjustment, but has the disadvantage that the cells are continually running down through the winding of the potentiometer. Grid cells in circuit can be varied only in steps of 1½ volts, but will last for a long period as the current taken from them is extremely small. In the instrument described, terminals are provided for grid cells, and the writer usually connects two or three cells in series between the terminals marked. If desired, the terminals can be shorted, whereupon the grid is maintained at approximately zero potential, but distinctly better results are obtained with cells in circuit

The switch to change from one valve to two is of the telephone switchboard type. The method of switching was suggested to the author by the article in the May 14th, 1921 issue of *The Wireless World*, p. 118. In the article referred to, a method was described by which the telephones could be connected to the plate of any particular valve of a multi-valve set, the valves not in use being switched off. In the case of the writer's instrument the method was not entirely applicable as it stood, as it was desired to use but one filament rheostat, for the reason that both valves perform the same function and can be controlled together. When only one filament rheostat is used for two or more valves, switching off one of them will mean a sudden increase in brilliancy of the remaining valve or valves, which is undesirable. The switching method was therefore modified so that besides changing the telephones from one plate to another, when the first valve only is used, the plate circuit of the last valve is broken. So long as both valves are in their sockets both filaments will be alight, even if one is not in use. When one valve alone is used for a considerable period the second can be removed from its socket and the filament resistance readjusted. Of course, if two separate filament resistances are used, the switch can be made to break the filament circuit of the second valve instead of the plate circuit. The writer did not consider the advantage so gained to be worth the cost of a further filament rheostat, but others may think differently. The modification necessary

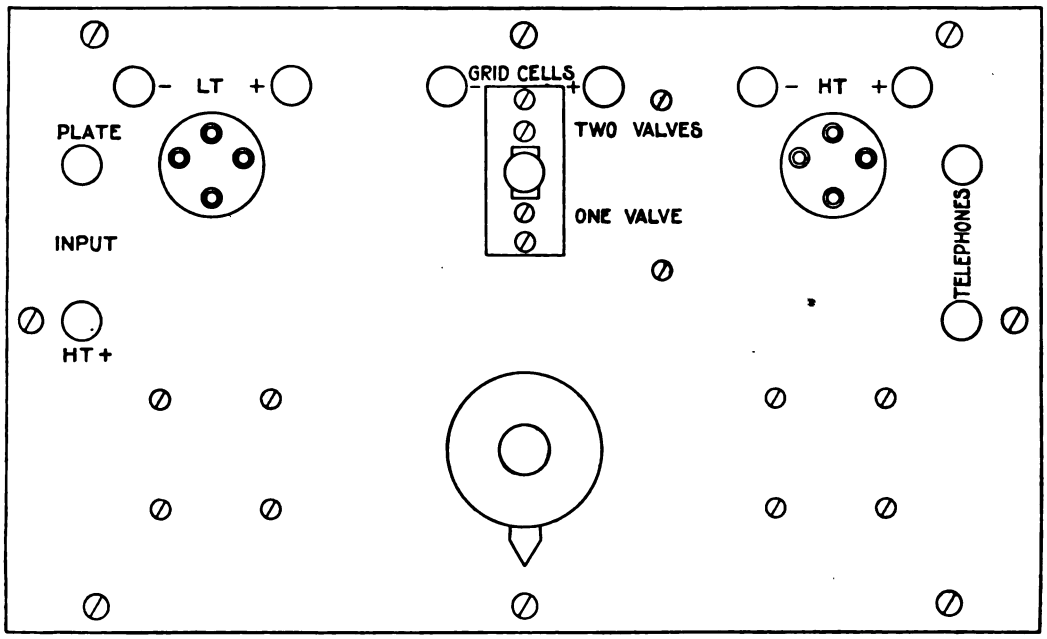


*Fig. 2. The lay-out of the panel.*



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to arrange this will be understood on studying the circuit diagram, Fig. 4.

Two fixed condensers are used, one across the high tension terminals (0·01 mfd.) and one across the telephone terminals (0·002 mfd.). This last is not very important in practice. All connections are soldered and the condensers are secured by the method described in the last article.

As first made up, the set was found to be oscillating at a frequency above audibility, the amplification suffering considerably. This was at once remedied by connecting together the primaries of the transformers in the way shown. At the same time the two cores were connected together, and to the positive pole of the H.T. battery. By making these two modifications all trouble from self oscillation ceased and the magnification was all that could be expected.

In view of the fact that full constructional details were given in the previous article, little need be said here regarding the actual fitting of parts and the connecting up. The most difficult matter is cutting an oblong hole to take the telephone switch. To do this, mark out on the panel the shape and size of the hole and then drill a number of round holes ntil the middle of the square falls out. Then take a file and carefully file away the ebonite until the limits of the marking are reached. It is not easy to do this, but on the other hand it is not so difficult as it sounds.

The intervalve transformers should be chosen carefully, and the dealer from whom they are purchased should be asked what type of valve they best suit. Certain transformers work best with certain valves. The army intervalve transformers, for example, work very well with V24's. Beware of cheap intervalve transformers of unknown make. They may burn out with strong signals and prove very expensive in the long run.

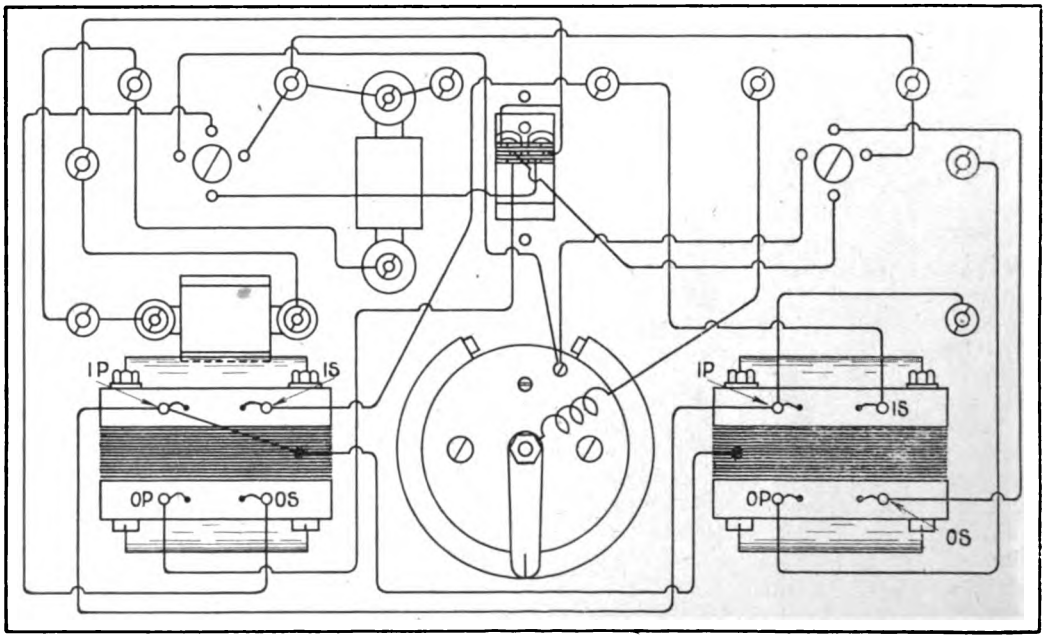


*Fig. 3. Wiring of the instrument.*

The transformers are best secured to the panel by drilling holes right through the ebonite of a size sufficient to allow clearance for a 6 BA screw with cheese head. The upper part of the hole should then be recessed with a drill of the size of the cheese head for just sufficient depth to allow the cheese head to fit flush when in place. To mark the position of the holes place the transformer in position and pencil through the openings in the frame. When the holes have been drilled and the screws pushed through, the transformer can be fitted over them and secured with nuts as shown.

Whatever transformers are used, see that

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the I.P., O.P., I.S. and O.S. terminals are connected as shown.

Other constructional details will be evident from the Figures 1, 2, and 3. If desired, clips for V.24 valves can be fitted instead of four-pin sockets, as the V.24 is a very good L.F. amplifying valve with most transformers.

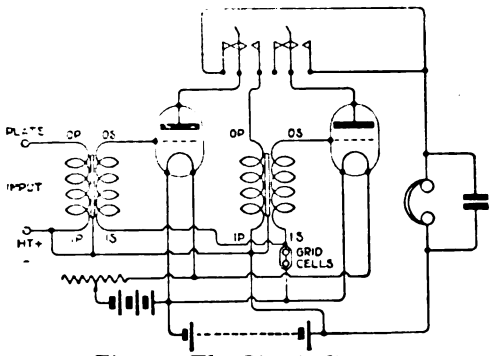


*Fig. 4. The Circuit diagram.*

NOTES ON THE COMPLETE STATION.

The writer ventures to think that any reader who follows the instructions given in these articles will be well satisfied with the station so built. At first there will be a little difficulty in tuning to signals, but after a little practice the difficulty will disappear. In most cases excellent results will be obtained on "stand-bi," with the condenser in parallel, and probably the majority of work will be done in this fashion. For the highest selectivity the "tune" adjustment is advisable, although it is rather more difficult to operate.

Readers who have a complete set of plug-in coils will be able to use the reactance-capacity method up to about 7,000 or 8,000 metres, with a 0·0001 mfd. condenser. Very little loss of efficiency will be found on long wavelengths with a larger condenser, so that much higher figures can easily be reached. With the resistance unit the longest waves can be received quite efficiently, and with much greater ease of tuning. For long waves, however, the writer prefers his three-valve set described in the issues of April 1st and 8th, using the new tuner in place of the converted "Mark III.," and with one of the note magnifiers added if four valves are required. There is little to choose between the two in regard to signal strength, the preference being largely due to the convenience of handling.

If it is found inconvenient to handle the reactance-tuning condenser behind the second unit, it can be stood in front and flexible leads taken across the instrument. All tuning condensers will then be in front of the set.

It is always advisable to use a telephone transformer, and this is best fitted in a separate box which can be connected either to the output terminals of the two-valve H.F. and detector unit, or to the output terminals of the note-magnifier unit. In this way, with only one telephone transformer, the set can be used with two, three or four valves and with a minimum of switching.

When listening to telephony it will rarely be necessary to use all four valves, except when a loud speaker is used.

It will be found very convenient to make a special box for the H.T. battery. The writer encloses five 15-volt units in a box just big enough to take them, the lugs being soldered together so as to give a total voltage of 75. The lid of the box is fitted with an ebonite strip with five large terminals, for negative 30 v., 45 v., 60 v. and 75 v. (positive).

Connections from the aerial and earth to the set are made with silk-covered electric lighting flex, the bared ends of the two wires being joined and soldered to tags. Leads to the L.T. and H.T. batteries are made of the same flex, the positive wire being knotted at each end so as to avoid confusion. The fact that the wires are twisted together is no disadvantage whatever in the case of the L.T. battery, and in the H.T. leads it is a distinct advantage, as the capacity effect adds to the value of the condenser shunted across the H.T. battery! Twisted electric lighting flex is also used for the connection between the two units, and from the telephone terminals to the telephone transformer.

Finally the whole set is placed within an oak bureau from which the pigeon-holes and other impedimenta have been removed. Interchangable coils, H.T. battery, separate heterodynes, spare telephones and the like are placed in the drawers below, so that the whole station is self-contained.

*Note.*—In the last article the H.T. negative of the H.F. and detector unit was shown connected to the L.T. positive. It should be connected to the L.T. *negative* if it is desired to use one accumulator for both units. The change is very simply made without disturbing other connections. There will be no difference in signal strength or efficiency.

So far thirty-four of the telephony transmitters listed in *The Wireless World and Radio Review* for July 1st have been heard on this set.

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# The Principles of Tuning in Wireless Telegraphy

By C. E. FIELD, B.Sc.

WHEN an amateur first takes up wireless telegraphy, he finds that the successful working of an installation depends upon certain electrical circuits being "in tune" with one another, and one of his most important pieces of apparatus is a "tuning coil." He is, however, frequently at a loss to know exactly what is meant by two circuits being "in tune," and if he endeavours to find out from a text-book he will probably be confronted with pages of mathematics which are of very little assistance.

Electrical tuning, however, which is the basis of satisfactory wireless transmission or reception, can be simply explained with the aid of analogies drawn from mechanical experiments, once the working of an electric circuit is thoroughly understood.

Consider first an ordinary steam engine. Steam from the boiler exerts pressure on a piston and produces mechanical movement. The greater the steam pressure, the faster will the piston travel, or in other words, the greater will be the amount of movement in a given time. Also, for a given speed, the pressure required depends upon the resistance that is offered to the motion of the piston.

In an electrical circuit, electrical pressure, or voltage, is supplied from some source, and produces a *movement of electricity*, *i.e.*, an electrical current. The greater the electrical pressure, the greater is the current it produces, and for a given current to flow, the pressure required depends upon the resistance of the circuit. This result is known as Ohm's Law, and is concisely expressed by the equation $V = IR$, an expression probably familiar to all readers.

Referring again to the steam engine, we know that if pressure is applied alternately to each side of the piston it will cause the latter to travel backwards and forwards, the speed of the piston being greatest in the centre of its stroke. In other words, an alternating steam pressure produces an alternating movement.

Similarly, in an electric circuit, an alternating or rapidly reversing voltage produces an alternating current, and Ohm's Law holds good for an alternating current circuit just as for a direct current circuit.

There are two other properties besides resistance which every electric circuit possesses in a greater or less degree. These are *inductance* and *capacity*, and it is these properties which are of the greatest importance in circuits connected with wireless telegraphy, and will now be discussed.

INDUCTANCE.

Any conductor carrying an electric current is surrounded by "lines of magnetic force," the number of which depends upon the value of the current flowing. If the value of the current changes, therefore, the number of lines of magnetic force changes, the lines either growing outwards in concentric circles from the centre of the conductor or shrinking into the conductor, which is cut by the lines of force as they do so. Now, whenever lines of magnetic force and a conductor cut one another, a voltage is set up in the conductor proportional to the number of lines of force cut per second.

Hence the changing magnetic field caused by a changing current produces a voltage in the conductor carrying the current, and this voltage acts in such a direction as to tend to maintain the current at its former value. *i.e.*, a back voltage is set up by an increasing current, and a forward voltage by a decreasing current.

The inductance of a circuit is a measure of the voltage set up by a given rate of change of current. If a rate of change of current of 1 ampere per second causes 1 volt to act in the circuit, the inductance of the circuit is 1 henry. If 2 volts are set up, the inductance is 2 henries, whereas if a rate of change of 2 amperes per second were required to produce 1 volt, the inductance would be $\frac{1}{2}$ henry, and so on.

Inductance is thus a property of a circuit which *opposes any change in the value of the current flowing*. An alternating current, therefore, which is continually changing, encounters considerable opposition in an inductive circuit.

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To obtain a mechanical property comparable with inductance, we must find that which tends to prevent any alteration in the rate at which a body moves. Inertia, or momentum, does this, and so a moving body with a large moment of inertia, such as a heavy pendulum, or flywheel, may be compared with an inductive circuit carrying current. A flywheel can only be brought up to speed, or brought to a standstill gradually, and a very great alternating force would be required to cause it to oscillate rapidly backwards and forwards through a small arc.

CAPACITY.

A condenser, which is the apparatus employed to give a circuit a large amount of capacity, consists essentially of a layer of insulating material such as mica or air, sandwiched between two metal plates.

When a voltage is applied to one of the plates, a current flows into the condenser, and fills, or "charges," it with a certain *quantity* of electricity. As the charge increases, the electrical pressure on the plate rises, in opposition to the impressed voltage, until the two pressures are equal, when no more current will flow into the condenser. The capacity of a condenser is a measure of the current required to produce a difference of pressure between the plates of 1 volt in 1 second. If this is brought about by a current of 1 ampere the capacity of the condenser is 1 *farad*. If 2 amperes are required, the capacity is 2 farads, and so on.

When a condenser is put in a closed alternating current circuit, the pressure on one plate relative to that on the other is alternatively raised or lowered, so that when one plate is gaining a charge of electricity, the other is losing a similar charge. A current therefore flows first into one plate and out of the other, and then in the reverse direction, so that an alternating current appears to go *through* the condenser.

The greater the capacity of a condenser, the greater is the current that flows into it when a definite voltage is applied, so that in an alternating current circuit the amount of current going "through" a condenser depends upon its capacity, *i.e.*, the greater the capacity of a condenser, the less the opposition it offers to an alternating current.

When a condenser is being charged, the back voltage across the plates increases, and so the current flowing becomes less and less, and finally stops. Thus, unlike an inductance, a condenser is always *trying to charge the value of the current*.

A comparison may be made between a condenser and a steel spring. If, say, a steel rule is gripped at one end in a vice, and the free end is bent backwards and forwards, the greater the deflection of the rule the greater is the pressure required to bend it any further, and if the pressure is kept constant, the slower does the movement become. The more flexible the rule, the greater is the movement that can be produced in a given time by a given pressure.

Thus the flexibility of the rule may be compared with the capacity of the condenser.

THE EFFECT OF DIFFERENT FREQUENCIES.

We must now see what is the effect produced by altering the rapidity, or frequency, with which an alternating pressure is applied to a circuit containing inductance or capacity.

If the pressure (or torque) applied to a heavy flywheel is very rapidly alternated, the flywheel will never have time to "get going" in either direction, and so very little movement will take place. Similarly, if a very rapidly alternating (or high frequency) voltage be applied to an inductive circuit, very little current will flow.

Thus the resistance effect due to an inductive circuit depends upon the frequency of the current, or voltage, as well as upon the value of the inductance. It can be shown that if a voltage of frequency $f$ cycles per second is applied to a circuit of inductance $L$ henries, the resistance offered to the current is given by $2\pi fL$ "apparent ohms," so that for an inductive circuit, neglecting any resistance, we can write Ohm's Law thus :—

$$V = C \times 2\pi fL.$$

If a rapidly alternating pressure is applied to the rule held in the vice, there will be no time for the rule ever to be deflected far in either direction, and so it will never offer much resistance to movement, which will consequently be very rapid.

Similarly, a high frequency voltage will send a large current "through" a condenser, or in other words, a condenser offers little opposition to high frequency currents.

Hence the resistance effect of a condenser varies *inversely* as the frequency, and also as the capacity, and it can be shown that Ohm's Law for a condenser is

$$V = I \times \frac{1}{2\pi fC}$$

where $C$ is the capacity in farads.

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Now we have seen that whereas an inductance always tries to *prevent* a current from changing, a condenser always tries to *make* a current change. The resistance effects of the two at any instant, therefore, work in opposite directions, so that in a circuit containing both inductance and capacity, the resistance effect of the two combined is the *difference* between their individual effects.

In such a circuit, therefore,

$$V = I \times \left(2\pi fL - \frac{1}{2\pi fC}\right),$$

the term in brackets being known as the *reactance* of the circuit, to distinguish it from the ordinary resistance, which is being neglected in the cases under consideration.

Let us now consider the circuits used in connection with wireless telegraphy.

The simplest, but fundamental wireless transmitting circuit consists of a condenser and an inductance coil joined in series, the two being shunted by a spark gap, the ends of which are connected to a high tension supply, such as an induction coil. (See Fig. 1.) When the electrical pressure is applied to the circuit, a current flows and charges the condenser. The pressure across the spark gap will always be the same as that across the condenser, and so, as the latter becomes charged, it is increased until it becomes too great for the electric strength of the air in the gap. When this occurs, the condenser discharges across the gap by means of a spark.

This action could be imitated by bending the rule in the vice, and letting it fly back. As there was some inductance in the electric

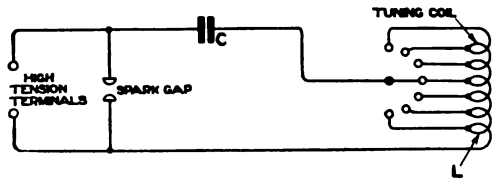


*Fig. 1. Simple Transmitting Circuit with Fixed Capacity and Variable Inductance.*

circuit, however, to make the comparison complete we must add some inertia to the mechanical "circuit," which could be done by fixing a lump of lead on to the free end of the rule. When this was allowed to spring back, it would continue vibrating for some time at a definite frequency, known as the *natural frequency* of the system.

If the lump of lead were very heavy, and the spring were very flexible, it would vibrate much less rapidly than if the reverse were the case.

The action of the condenser discharge in the electric circuit is exactly similar. When the spark passes across the air gap, a very rapidly alternating current passes round the circuit, oscillating backwards and forwards, and gradually dying away. The greater the inductance or capacity in the circuit, the lower is the frequency of this current.

The rapidly alternating discharge across the spark gap sends out "wireless waves," the length of which depends upon the frequency of the discharge (not to be confused with the frequency with which the sparks pass across the gap, this being determined by the rapidity

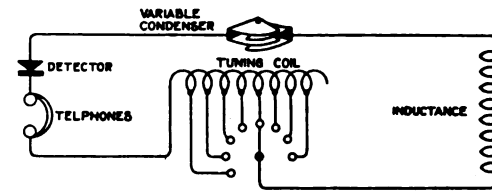


*Fig. 2. Receiving Circuit with Variable Condenser and Auxiliary Tuning Coil.*

with which the primary current of the induction coil is interrupted, if the high voltage is supplied by that means). The length of the wave in centimetres is given by dividing the frequency into the velocity of light, the latter being 30,000 million centimetres per second.

For example, a wavelength of 300 metres is produced by a circuit having a natural frequency of 1,000,000 cycles per second.

The wavelength can therefore be adjusted by altering either the capacity or the inductance of the transmitting circuit.

As it is much more convenient, the inductance is usually altered (by increasing or decreasing the size of that portion of the inductance coil included in the circuit), and it is this variable inductance that is known as a "tuning coil."

This "tuning coil" may constitute the whole of the inductance in the circuit as in Fig. 1, or it may be an additional coil, as shown in Fig. 2, which represents a simple receiving circuit.

A receiving circuit is exactly similar to the transmitting circuit described, except that the place of the spark gap is taken by a detecting apparatus, show in Fig. 2, by a pair of telephones and a crystal detector, and the only

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electrical supply to the circuit is the high frequency disturbance coming from the transmitting station.

Suppose that waves coming at a frequency of 1,000,000 per second strike the receiving circuit, a voltage and consequent current of the same frequency will be set up in the circuit.

Now we have seen that the reactance of this circuit is given by the expression

$$2\pi fL - \frac{1}{2\pi fC}$$

If we want the current flowing in the circuit to be a maximum (which we do, for the amount of energy caught by the circuit is exceedingly small) the reactance must be as small as possible, and obviously this occurs when

$$2\pi fL - \frac{1}{2\pi fC} = 0.$$

$$\therefore 2\pi fL = \frac{1}{2\pi fC}.$$

$$\therefore f^2 = \frac{1}{2\pi \times 2\pi \times CL}.$$

$$\therefore f = \frac{1}{2\pi\sqrt{CL}}.$$

Hence, if the inductance or capacity in the circuit is adjusted to such a value that

$$f = \frac{1}{2\pi\sqrt{CL}}$$

there will be no reactance in the circuit, and the high-frequency voltage will only have the negligible resistance of the wires to overcome.

In the receiving circuit, therefore, just as in the transmitting circuit, a "tuning coil" is employed, and is adjusted until the reactance in the circuit is a minimum, which is indicated by a maximum noise in the telephones. A "tuning condenser" is frequently used as well as a "tuning coil," although it is not generally given that name.

It may at first sight appear as if there were no need to have any inductance or capacity in a receiving circuit, since some trouble is expended in making them neutralise one another.

A circuit containing only resistance, however, would be like a piece of thick copper wire held in a vice, there being nothing tending to make an oscillatory movement take place.

It can be shown mathematically that the natural frequency of the transmitting circuit (or of any circuit) is also given by the expression $f = \frac{1}{2\pi\sqrt{CL}}$, which really means that a circuit naturally discharges in such a way that a minimum amount of work is done in overcoming reactance. Thus in each circuit, the value $\frac{1}{2\pi\sqrt{CL}}$ is the same, and so the value of $L \times C$ must be the same in both. When this state of affairs has been brought about, the two circuits are said to be "in tune," or "tuned to the same frequency."

Next time, then, that you "tune up" your wireless set, remember that you are simply altering the value $L \times C$ in your circuit until it is the same as the corresponding value in another circuit, possibly hundreds of miles away, and you are using exactly the same principles as when you regulate a clock by altering the length of its pendulum.

In this article, no mention has been made of aerials, only the most fundamental circuits being considered. An aerial circuit is exactly similar to those described, except that the aerial wire acts as one plate in the condenser, and the earth acts as the other, the air between being the insulating material.

It is, of course, quite impossible to deal at all fully either with wireless circuits or with electrical vibrations in an article of this length, but it is hoped that some may be encouraged to look a little deeper, and gain a clearer conception of the true nature of any electrical phenomena they may encounter in working wireless or other apparatus.

## Wireless Exhibition & Convention

WIRELESS Societies are coming into being all over the country. Those which have firmly established themselves have in most cases affiliated with the Wireless Society of London. At the Convention which is to be held from September 30th to October 7th of this year members of affiliated societies will have an excellent opportunity of meeting with the members of other societies.

Great benefit may be derived from the Exhibition by those amateurs and experimenters who are not yet associated with any society. The social element of the clubs assembled, coupled with an atmosphere of scientific gregariousness, should be an impetus to all who are interested in wireless matters to encourage unity.

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# A Liverpool Amateur Receiving Station

By SAMUEL LOWEY.

THE writer received his post-war permit about the middle of October, 1919, and at once commenced experiments. The aerial installed was an indoor one consisting of four 28-ft. lengths at greatest height of 27 ft. above ground, and, with the exception of a period when, owing to earthing in damp weather, four 12 ft. lengths were temporarily installed, has been in use since that time. Its capacity is over half a milli-microfarad, the single down lead being 3/20 cab tyre sheathed cable.

After trying numerous types of inductance coils, including an elaborate one wound on 21 pegs in a board, missing three pegs each time as shown in Fig. 1, giving a coil of extremely low self capacity, the opinion was formed that the merits of single layer coils, especially for the longer waves, had been overrated.

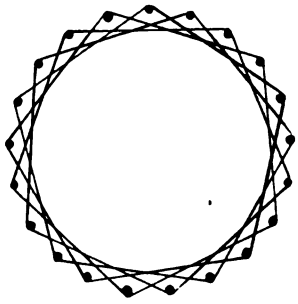

*Fig. 1. Showing method of winding a coil.*

Finally, dry wood formers were turned and grooved, as shown in Fig. 2, the largest pair being rather over 3 ins. diameter and wound with 100 turns of 36 S.W.G. in each slot to give an inductance value of a tenth of a henry.

Tappings were left out at grooves 5, 7 and 10, and on trial these were found to give excellent results, the best adjustment of coupling being obtained by sliding the end of one coil on to the end of another, when a definite zero of coupling could be reached, or coupling in the reverse sense obtained if required.

The next pair of coils was wound using identical formers, about 48 turns per slot being used, the arrangement being such that consecutive tappings gave about the same percentage change in inductance value.

In the box, shown in Fig. 3 with one end and front removed, may be seen one pair of coils mounted in position, the lower or A.T.I. coil being attached to a loose board which slides in the bottom of the box, while the secondary coil is attached to the underside of the box top.

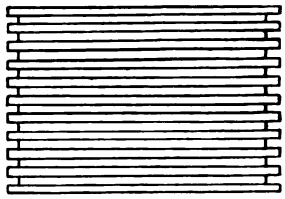

*Fig. 2. The former with slots cut.*

The bottom of the box has transverse grooves cut to accommodate any wood borings, etc., that might prevent the free movement of the sliding board.

A thin board is screwed at right angles to the moving board, and carries the switches for the A.T.I. (Fig. 4), the connections to arms of switches being by two flexible cords to a reversing switch mounted on top of box.

Only four wires enter the box; two for A.T.I. and two for secondary, all other connections being external.

The secondary switches are on top of the box, being identical with the A.T.I. switches just described.

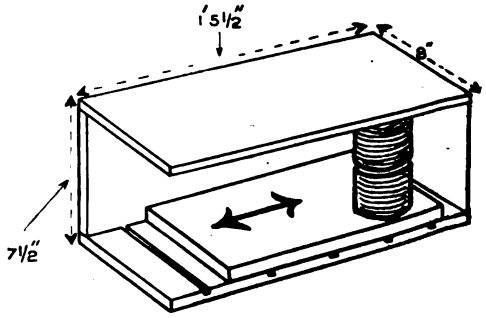


*Fig. 3. The box in which coils are mounted.*

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Coil 5 (Fig. 4) is on a smaller grooved former (13 slots), with tappings at grooves 10 and 13.

Coil 4: Single layer, range to about 1,800 metres, with 0·0005 microfarad capacity, and has four tappings.

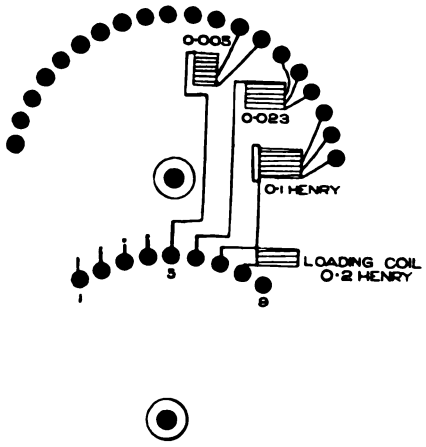


*Fig. 4. Showing tappings.*

Coil 3: Loose coupler pattern, four tappings, 200 to 800 metres, while coil 2 is a basket coil with three tappings from 600 to 1,100 metres.

When all switch arms are on the first contact, connection is made to four terminals enabling any special coils to be used. The secondary coils are exactly similar to the A.T.I. coils.

In the photograph (Fig. 5) the aerial tuning condenser is on the left of the primary switches, and the secondary condenser is on the right, the latter being fitted with a brass flat spring connected to moving vanes of condenser, the distance from the fixed vanes being variable by a screwed brass plug with long ebonite handle.

This makes an excellent vernier, having a maximum capacity of about 0·000015 mfd.

The valve panel is mounted on the top of the box, and the method of construction is indicated in Fig. 6.

The resistance wire for filament rheostats is wound in a shallow screw thread cut in a 5/16 in. diameter fibre rod.

The connecting wires are through holes bored in solid ebonite, all connections being soldered.

The valve sockets are ¼ in. Whitworth brass screws drilled ⅛ in. to take valve pins.

The intervalve L.F. transformers are mounted in a box fixed at back of tuner.

The number of turns on such transformers may apparently be varied between wide limits without much difference in results.

The first transformer made had a primary of 6,000 turns, secondary 30,000 turns of No. 42 enamelled.

Later transformers had 8,000 and 24,000 turns of No. 40 silk covered, 10,000 No. 36 silk covered to 30,000 turns of No. 42 enamelled.

The number of secondary turns, above 20,000, did not seem to matter much, but a good primary (about 10,000 turns) having an inductance of about 8 henries seemed an advantage.

The transformer windings were on old wire bobbins, and in constructing these, the writer soon gave up the common method

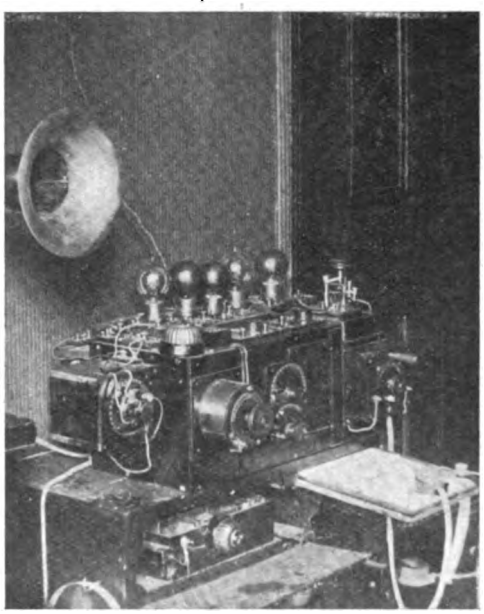

*Fig. 5. View of the complete set.*

of joining a heavier wire to start and finish of winding wire and found it more reliable to bring out the fine wires themselves, soldering them carefully to unscrewed part of brass wood screws in flanges of the bobbins, the windings always being connected as shown in Fig. 7, it being quite easy to solder connecting wires after the transformers were completed.

After boring and turning the bobbins to size, they were boiled for some hours in paraffin wax; this process always elongates

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the bobbin, and if wound first and boiled after a space is usually left.

It was found advantageous when using three L.F. transformers to reverse the direction when starting to wind the secondary of one

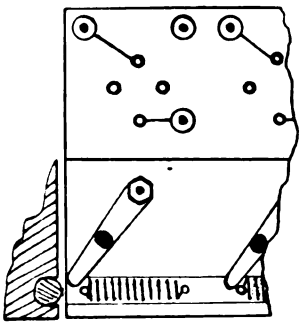

*Fig. 6. Valve panel mounting.*

(the middle) transformer; it seemed to stop low frequency coupling between transformers.

The telephone transformer has 10,000 turns of No. 36 (silk) for primary and 1,000 turns of No. 28 (silk) for the secondary. It is used with single 60 ohm "Brown A" telephones connected in parallel.

The loud speaker is a "Brown A" telephone fitted with phonograph trumpet. Instead of the standard 60 ohm winding 2 × 700 turns, it is wound with 2 × 400 turns of No. 36 silk covered.

The apparatus as described up to now was completed at Easter, 1920; in June, 1921, a variable H.F. transformer was added (extreme left of photo).

The coils were wound in shallow grooves in cylindrical formers similar to that shown in Fig. 2. The advantage of this type of transformer is that while it gives a reasonably tight coupling (about 75 per cent.), the capacity between windings is low.

The transformer for wavelengths 4,000 to 23,000 metres is about 3 ins. diameter, while for the smaller wavelengths it is $1\frac{1}{2}$ ins.

Both were wound with No. 42 silk-covered copper, the direction of winding being such that at one end the plate and grid wires came

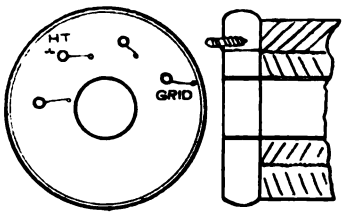


*Fig. 7.*

out clockwise and counter-clockwise respectively.

The control of both is made by an 8-way 4-pole switch. The circuit diagram is given in Fig. 8. In these days Morse is getting neglected generally, and the range has to be expressed in terms of music.

2 MT came in very well on three valves

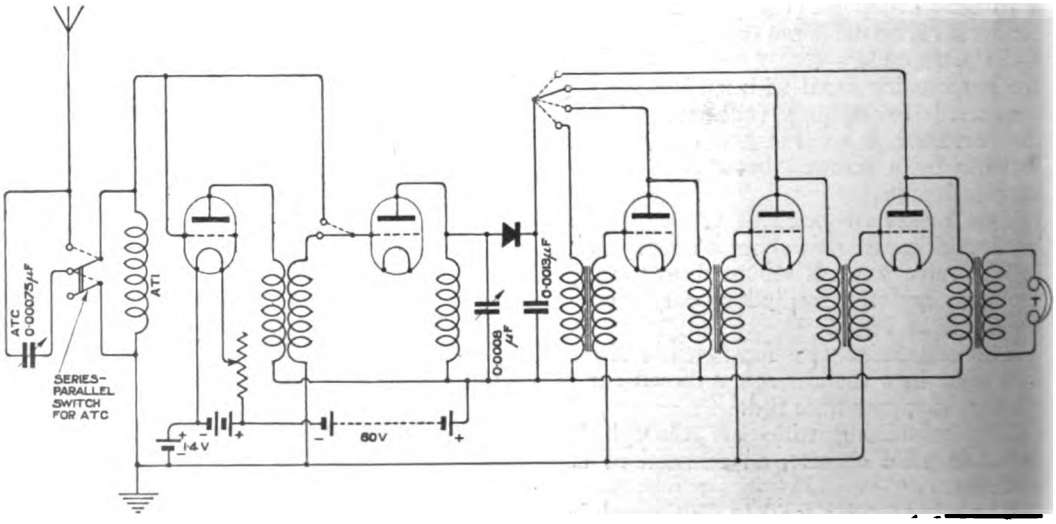


*Fig. 8 Circuit diagram.*

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on 700 metres, but since the change to 400 metres it is not received so well.

2 LO is quite good on three valves, and FL music is quite clear all over the house on five valves, while the Marconi installation for the Mersey Docks and Harbour Board beats the lot.

PCGG is audible four feet away, using three valves. A Johnsen-Rahbek loud speaker is sometimes used instead of a "Brown," being nearly as good.

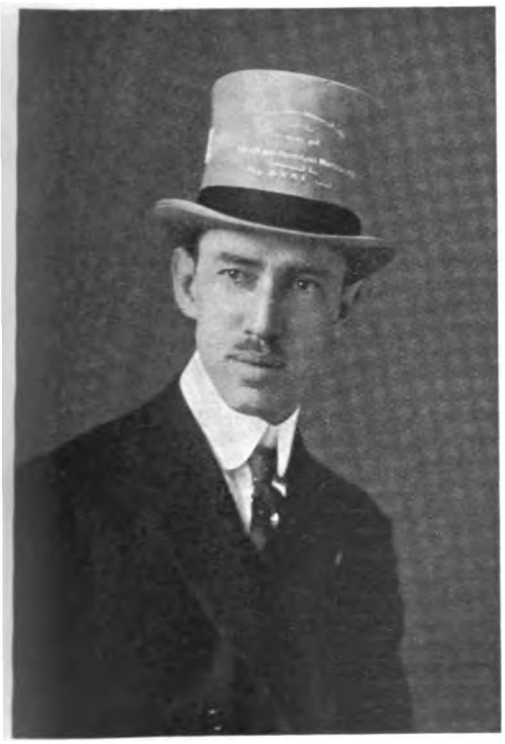
It has a slate drum—not agate. The set has now given quite a number of demonstrations with great success.

On the last occasion it was in competition with a steam organ on a roundabout at a recent garden fête, and won easily, the telephony (including an amateur transmission) being quite loud, and every word audible in the next room with door shut.

No apology is offered for the presence of crystal detector on the set; the writer considers it to be far more efficient and reliable than any method of valve rectification.

# International Amateur Wireless

THE hat which is seen here being worn by Mr. K. B. Warner, of the American Radio Relay League, has a history. It will be remembered that a photograph of the hat appeared in our issue of April 29th, when it was announced that the hat had just been despatched to Mr. Warner by Mr. W. W. Burnham, who had taken on a bet of a "new spring hat" in connection with the Transatlantic Amateur Tests.



In the July issue of *Q.S.T.* Mr. Warner acknowledges receipt of the hat, and has posed for the photographer. In referring to the tests, Mr. Warner acknowledges the success of the British amateurs, and says: "Radio history was written, of course, with those tests, and although the British amateurs were equally as successful as Mr. Godley, the bet of the new spring hat still stood. Mr. Burnham promptly cabled "congratulations. Cable size of hat," and the result is the special "lid" of our photograph.

After describing the decoration and inscription on the hat, Mr. Warner says:—

"We must express our great admiration for the beautiful way in which Mr. Burnham 'came through.' We thank you, sir, and send cordial greetings to the British amateurs you typify. While the hat is hardly one which we would feel safe in wearing to church on Sunday morning, it is nevertheless our intent to wear it on official A.R.R.L. occasions. It fits perfectly; thank you—our normal head size having been given you in spite of the temporary swelling that existed immediately after the success of the test," and he closes with the hint, "Now who wants to bet us something about a cutaway coat?"

The hat is of light grey felt and bears on one side the Stars and Stripes, and on the other the Union Jack united by wireless flashes encircling the crown. In front can be seen the inscription of dedication. Unfortunately, the photograph does not give a true estimate of the artistic appearance of the hat as the effect of colour is lacking.

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# Notes

### Extension in India.

Madras Wireless Station is to be converted into a high-speed automatic plant for working inland and to Rangoon. It is reported that the Rangoon section will replace the present land lines and cables from Calcutta to Rangoon for traffic between India and Burma. According to Lloyd's List the present apparatus for communicating with ships is to be replaced by a small station to be erected near St. Thomas's Mount. This will render the working with ships easier than hitherto, and at the same time free the big station in Madras for inland work.

The Department of Public Works now have the work in hand of extending the present station and also the erection of the new station at St. Thomas's Mount. The bulk of the new apparatus and plant has already arrived, and it is hoped that the stations will be completed and ready for work before the beginning of next year.

### P.M.G. on Reception in Cinemas.

A firm of picture theatre proprietors who had installed apparatus for providing audiences with broadcasted music have received the following letter from the Postmaster-General:—

"With reference to your letter of 11th inst. and telegram of the 24th inst., I am directed to inform you that, pending the receipt of the proposals of the representatives of the wireless manufacturing companies concerning wireless broadcasting stations, the Postmaster-General is unable to issue permits for the use of wireless receiving apparatus for public entertainments in cinemas, etc., or to say under what precise conditions such permits will be issued. As at present proposed, however, permits of this kind will cover reception only from broadcasting stations in this country. The Postmaster-General hopes to be in a position to make further announcement later."

### Motorists' Concert.

On July 29th a concert was transmitted by the Jowett Light Car Social Club, Bradford, for the benefit of its members and all other motorists who cared to accept an open invitation. Demonstrations were given at 3.30 p.m. and 6.30 p.m., each lasting about an hour and a-half. In the evening a speech was transmitted by the Lord Mayor of Bradford for the special benefit of the assemblage. Mr. Bever, a member of the Club, has recently experimented with an adaptation of a relay and stentorphone set. His efforts were so successful that it was decided to make use of high power telephony amplification as a means of entertainment with a view to fostering camaraderie among motorists by inviting them to a demonstration.

### Regulations in France.

According to the *Times* the departmental committee appointed by the French Under-Secretary of the Post Office to inquire into the regulation of wireless installations have drawn their report. It is expected that rules based on their recommendations will shortly be issued.

The broad principle followed is that receiving apparatus may be freely used after formal registration, while sending apparatus can only be installed by private individuals on the authorisation of the Under-Secretary of State acting on the advice of a mixed committee of officials and experts. Sending installations will be divided into five classes—private stations, stations for financial news, scientific stations, mobile stations (*e.g.*, of ships), and amateurs' installations. There will be a limit of wavelength.

### Honour for Senatore Marconi.

Senatore Marconi, G.C.V.O., LL.D., D.Sc., was elected a Vice-President of the Royal Society of Arts on July 28th.

### Successful Demonstration.

An open-air demonstration at the small hamlet of Bolton Villas proved highly successful on July 17th. The whole of the inhabitants listened to a programme of music and conversation carried out by a concert party assembled at Heaton. Reception was particularly loud.

### Report of Research Board Sub-Committee.

A report has just been issued of the Radio Research Board Sub-Committee which was appointed on October 4th, 1921, to investigate the subject of telephony dovelopment. Witnesses were heard from the Navy, Army and R.A.F., the Marconi Company and the Radio Communication Company. The report (Cmd 1,707) is signed by Admiral Sir Henry B. Jackson, Professors C. L. Fortescue and G. W. O. Howe, and Major A. G. Lee.

### Call Sign 2 FU Misused.

**2 FU** complains that his call sign is being used by another transmitter. The use of another man's officially recognised sign is likely to lead to serious trouble.

### Air Route Call Sign Amendments.

Notification is made by the Air Ministry as follows:—

1. With effect from August 1st, 1922, the W/T call signs of Haren, Air Port of Brussels **(BAV)**; Brussels, Royal Meteorological Institute **(HS)**; and Ostend **(OPV)** have been altered as follows:—

| | |
|---|---|
| Haren (Air Port of Brussels) | **OPVH** |
| Brussels (Royal Meteorological Institute) | **OPO** |
| Ostend | **OPVO** |

2. The following changes in transmissions from Brussels **(OPO)** have been effected:—

(*a*) The meteorological reports transmitted on 1,400 metres at 0715 and 1325 G.M.T. have been discontinued.

(*b*) The report hitherto transmitted on 1,400 metres at 1815 is now transmitted on 1,680 metres at 1824 G.M.T.

Other routine transmissions remain unaltered.

3. The tables in Section II (Belgium), paragraphs 4 and 5, of Notice to Airmen No. 43 of 1922 are amended accordingly.

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**Death of Dr. Graham Bell.**

Dr. Alexander Graham Bell passed away on the night of August 1st-2nd.

We deeply regret to learn of the passing of a pioneer among scientists whose lifework has made vast revolutions in the daily conduct of industry and every form of business. His research work in connection with the telephone has had results which are beyond estimation. He was born at Edinburgh on March 3rd, 1847, educated at the High School and the Edinburgh University, went to America and became professor of vocal physiology at Boston University, where he made his first telephone apparatus in

1875. He transmitted speech over a long distance for the first time in August, 1876.

The experiments were conducted in Canada and the Dominion Telegraph Co.'s wires were used, a transmitting apparatus being installed at Paris, Ontario, and a receiver placed at Brantford, eight miles away. A few months later conversation was possible both ways, and the present-day telephone was born.

Dr. Graham Bell held the Albert Medal of the Royal Society of Arts since 1902, the Hughes Medal of the Royal Society since 1918, and several honorary degrees. He was a freeman of Edinburgh, the freedom being conferred in 1920.

# Calendar of Current Events

**Sunday, August 13th.**

Transmission of Telephony from 2.30 to 5 p.m. and from 8 to 9 p.m. on 1,085 metres by **PCGG** The Hague, Holland.

**Monday, August 14th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7.30 *p.m.*—At Signal Corps Headquarters, Park Street, Hull. Lecture on "Accumulators, their Use and Abuse," by Mr. J. Nicholson.

**Tuesday, August 15th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT**, Writtle near Chelmsford.

WIRELESS SOCIETY OF EAST DORSETSHIRE.

At Branksome Liberal Club, Salisbury Road, Upper Parkstone. General meeting and enrolment of members.

**Wednesday, August 16th.**

YORKSHIRE WIRELESS SOCIETY.

8 *p.m.*—Grand Picture House Café, Clarence Street, York. Preliminary meeting.

**Thursday, August 17th.**

Transmission of Telephony at 8 to 9 p.m. on 1085 metres by **PCGG**, The Hague, Holland.

**Sunday, August 20th.**

Transmission of Telephony from 2.30 to 5 p.m. and from 8 to 9 p.m. on 1085 metres by **PCGG** The Hague, Holland.

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY.

Field Day.

**Tuesday, August 22nd.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT**, Writtle, near Chelmsford.

**Thursday, August 24th.**

Transmission of Telephony at 8 to 9 p.m. on 1085 metres by **PCGG**, The Hague, Holland.

ILFORD AND DISTRICT RADIO SOCIETY.

At St. Mary's Hall, High Road, Ilford. Lecture on "Short Wave Reception—with special reference to Damped Waves," by Mr. E. E. Hale.

# Books Received

ELEMENTS OF RADIO TELEPHONY. By William C. Ballard, Jr., M.E. (London: *McGraw-Hill Publishing Co., Ltd.* 1922. 7½" × 5¼").

RADIO FOR AMATEURS. By A. Hyatt Verrill. (London: *William Heinemann.* 1922. 7¾" × 5¼").

**Sir William Noble's Future Work.**

It is understood that Sir William Noble, who has been elected to the Board of the General Electric Company, will in future devote his attention chiefly to the wireless and telephone side of that company's development.

**Hotel Wireless.**

The "New Metropole," Northumberland Avenue, London, claims to be the first London hotel to be equipped with a wireless telephone receiver. The apparatus was installed by the engineer of the Gordon Hotels, Ltd., Mr. W. J. Crampton, M.I.E.E.

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# Wireless Club Reports

***NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.***
**The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## Stoke-on-Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley, Stoke-on-Trent.

At a meeting of the Stoke-on-Trent Wireless and Experimental Society on Thursday, July 27th, it was unanimously decided to change their headquarters to the new Y.M.C.A. building in Marsh Street, Hanley. Since the Wireless Exhibition, held under the auspices of the Society a few months ago, the membership has nearly trebled, and it has been felt for a long time that their present headquarters were far from satisfactory. The Y.M.C.A. have kindly offered the Society the use of their lecture room for meetings and experiments, and the offer has been accepted. A meeting will held in the new headquarters at 7.30 p.m., August 3rd.

It was also decided to send a delegate to the conference of the Midland Wireless Societies, to be held about the end of August, in order to arrange the interchange of lecturers.

Mr. W. J. Forster (Member) read a paper on "Electrical Measuring Instruments."

After first elucidating some of the more common electrical terms, the lecturer explained the working principles and construction of various types of ammeters, voltmeters, wattmeters and energy meters, as used in modern power-station practice and by consumers. He clearly pointed out the difference between pressure measuring instruments, and some actual instruments were available, the insides of which the members were able to inspect for themselves, and note the difference.

In the subsequent discussion, the importance of electrical measuring instruments in wireless work was emphasised, and how that without them we should not know what the exact conditions were in our circuits, especially for transmitting stations, and progress would hardly have made such rapid strides without their use. It was also remarked that Mr. Forster had not touched upon galvanometers, and the hope was expressed that he would give a lecture on what was perhaps the most widely used measuring instrument among wireless amateurs.

A vote of thanks, carried unanimously, brought the meeting to a close.

## Sunderland and District Amateur Radio Society.*

Hon. Secretary, Mr. H. Burnley, 8, Briery Vale, Ashbrook, Sunderland.

The above Society is being reformed, and has changed its headquarters and name. The new name is "Sunderland Y.M.C.A. Radio Society." All communications should be addressed to the Hon. Secretary at the above address.

## Folkestone and District Wireless Society.*

Hon. Secretary, Mr. H. Alec S. Gothard, A.M.I.R.E., 8, Longford Terrace, Folkestone.

A General Meeting of the above Society was held at Cave's Café on Wednesday, July 5th, at 7.30 p.m., Mr. A. H. Ullyett in the chair.

The meeting proved very successful, and the following were elected to serve until July, 1923:—President: His Worship the Mayor, Mr. R. G. Wood. Past President: Mr. T. Hesketh, M.I.E.E., A.M.I.Mech.E., M.A.I.E.E. Vice-President: Capt. St. John Butler, R.C.S.† Vice-Chairman: Mr. A. G. Mills.† Committee: Messrs. L. Curtis.† A. G. Cox, A. Cumberbirch and T. C. Gilbert. Hon. Treasurer: Mr. R. W. Piper.† Hon. Secretary: Mr. H. Alec S. Gothard, A.F.Aer.Inst., A.M.I.R.E.†

After the programme for the forthcoming year had been discussed, the meeting adjourned at 9.45 p.m.

On Wednesday, July 26th, a very successful demonstration in radio-telephony was given by Mr. C. G. F. Pritchett, who had made special arrangements with Mr. Bligh, of Canterbury, to transmit on that evening for the benefit of the Society. Mr. Pritchett took great pains in explaining the methods of working the circuits employed. A hearty vote of thanks was given to both Messrs. Pritchett and Bligh, the first for his successful efforts in obtaining the transmission, the latter for his kindness in transmitting.

The activities of the Society are at present carried on in a private room at Cave's Café, Sandgate Road, Folkestone, where meetings are held at 7.30 p.m. every Wednesday.

Mr. Cox has very kindly consented to give quarter hour buzzer practice every week before the meeting. Members who desire to take advantage of this opportunity of practising their Morse are requested to be at the club-room at 7.15 p.m.

Full particulars as to membership, etc., can be obtained on application to the Hon. Secretary.

† Denotes re-election.

## North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 96th meeting of the Club was held on Wednesday, July, 26th in Shaftesbury Hall, Bowes Park. The chair was taken at 8.30 p.m. by Mr. G. Evans, who introduced Mr. F. H. Haynes, who had kindly consented to lecture on the "Johnson-Rahbek Loud Speaker."

Mr. Haynes had brought to the hall the instrument which formed the subject of his lecture, and this was on view during the evening. He described the action of the instrument, and illustrated his remarks by diagrams drawn on the blackboard. He also explained the construction,

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more particularly with regard to the agate cylinder which forms an essential part of the instrument, and drew the attention of the audience to the importance of obtaining even electrical contact between the agate cylinder and the steel spindle on which it is fixed.

The instrument was then set in operation, and a demonstration given of its capabilities. The principle on which it works, which has already been described in *The Wireless World and Radio Review*, is most interesting, quite apart from its possible commercial application, and it was evident from the questions put to Mr. Haynes at the close of his lecture that several members had already decided to experiment in the same direction.

When the Chairman called for a vote of thanks to Mr. Haynes, which was heartily responded to, he mentioned that Mr. Haynes had applied for membership to the Club, an announcement which gave great satisfaction to all present, and another talk from him at an early date will be welcomed by members.

Particulars of the Club may be had on application to the Hon. Secretary.

### Newcastle and District Amateur Wireless Association.*

Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

A General Meeting of the above Association was held at headquarters on Monday, July 24th.

Dr. Smallwood was present for the first time since the last general meeting, and gave thanks to the assembly for his election as President of the Association. The President then called on Mr. Dixon, the Chairman, to read out certain alterations to the existing rules. The amendments then proposed, seconded and carried, were:—(1) That all candidates must be over 21 years of age and to fulfil the conditions as stated in the P.M.G. licence. (2) All applicants to send in cards with applications and proposal forms to the committee, stating name and address, at least one week before the next committee meeting. (3) No visitor to be admitted more than three times per year either by one member or more than one member.

Copies of the amended rules will be supplied to all members. It was then proposed and seconded that Mr. M. C. Jones should be appointed Assistant Secretary.

Mr. Dixon then gave his lecture upon wavelengths and wavemeters in general. After dealing with the advantages obtained by using a wavemeter, Mr. Dixon went on to describe the Park wavemeter. He explained in detail the method of using this instrument to tune the receiving set preparatory to receiving another transmitting station. He then went on to describe the honeycomb inductances contained in the meter which he stated were effective to 8,000 metres, dealing at the same time with the combinations possible with parallel fixed condensers.

With the aid of diagrams, Mr. Dixon explained in a most interesting manner the method of calibrating external inductances by cutting out the internal inductances, and of calibrating condensers by comparison with the standard condenser contained in the wavemeter.

He then went on to deal with the static potentiometer method, describing with diagrams the method of tapping the inductances by connecting between two condensers in series across the inductance. He demonstrated how different capacity condensers affected the position of the tapping and observed that he had obtained very satisfactory results on wavelengths as high as 25,000 metres.

After further explanation of the large capacity grid condenser and the low resistance grid leak to prevent howling, the method of using the meter as a separate heterodyne was put forward.

The members were then informed of the case of a local amateur who was using a valve receiving set without the P.M.G. licence. Owing to his instrument howling incessantly he was located from the Berwick and Stockton-on-Tees direction finding stations, illustrating the remarkable amount of damage which a badly handled valve set could do.

### Newport and District Radio Association.

Hon. Secretary, Mr. Edward R. Brown, M.S.A., A.T.P.I., 92, Corporation Road, Newport.

On Thursday evening, July 13th, the above Association held their second enrolment meeting at the Boys' Municipal Secondary School, Newport.

Before a large and enthusiastic audience Capt. C. H. Bailey (Vice-President) gave an address, in which he expressed the opinion that America was at the present ten years in advance of England as far as wireless was concerned, but that if British amateurs were given better facilities for experimenting they would beat the Americans in three months. The lecturer also gave some very interesting reminiscences of a visit to New York.

An excellent demonstration was given on a splendidly equipped set, and a detailed explanation of same was given to the members.

A large number of new members were enrolled and a pleasing announcement made that a large hall in the centre of the town had been obtained for headquarters.

A buzzer class is to be held throughout the winter months, and an immediate start is to be made towards a library collection.

A well-attended meeting of the above Association was held on Thursday, July 27th, at Headquarters, Memorial Institute, Queens Hill, Newport.

Mr. E. Ogden, of Cardiff, gave a lecture on "Points to Beginners," and Mr. J. H. M. Wakefield presided. The lecturer advised all amateurs to get into the theory of wireless, which was an elementary essential. He indicated the various books and journals the amateur should read.

Commencing with the aerial, the lecturer proceeded to take each part of a simple set, illustrating with diagrams their functions, faults and remedies. and in a simple order of sequence eventually worked up to a complicated valve set.

The lecture was closely followed by the members, who at the end bombarded Mr. Ogden with questions. Enthusiasm ran very high, and the speaker was invited to give a further address in the near future, he being promised a warmer time at questions.

On the motion of Mr. W. B. Edwards, seconded by Mr. H. W. Winslow, Mr. Ogden was heartily thanked. Replying to the vote the lecturer congratulated the Association upon the rapid strides made.

The membership now stands at 135.

Intending members in Monmouthshire should communicate with the Secretary.

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**The Ealing Wireless and Scientific Association.**

Hon. Secretary, Mr. Wm. Frank Clark, 52, Uxbridge Road, Ealing, W.5.

The third meeting of the above Society having been held at the Vestry Hall, Ranelagh Road, Ealing, W5., the Association may now be considered safely launched upon a career of great usefulness in the immediate locality.

It has been decided, in view of the fact that so many of the members are beginners in the new science, to commence with a series of elementary lectures, in which branch of the club's work Mr. A. Snell is contributing a very valuable part after some twenty years of wireless telegraphy in all its branches.

At the meeting held on July 22nd, 1922, Mr. Snell gave, in an informative and eloquent manner, an outline of the electron theory of matter, and explained how very important this subject is in the theory of wireless.

A cordial welcome is extended to all who care to accept membership with the Society, and those who contemplate joining are urged to take advantage of these first series of lectures.

As soon as circumstances permit, an aerial will be erected and practical work and demonstrations undertaken.

**The Wireless Society of Hull and District.**

Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull.

There was a large attendance of members on the occasion of the second annual meeting of this Society, which was held at the Signal Corps Headquarters, Park Street, on July 10th.

Mr. G. H. Strong (President) occupied the chair, and was supported by Capt. W. E. Dennis, R.C.S., and Mr. Hy. Strong (Acting Vice-Presidents). The Secretary's report showed that much progress had been made, many interesting and instructive lectures and demonstrations having been held during the year. The membership had been increased to over 50. The report concluded with a vote of thanks to Capt. Dennis for his kindness in placing the room at the disposal of the Society for its meetings. The Hon. Treasurer's statement showed a balance in hand of £17 15s. 10d. This, together with the Secretary's report, was considered very satisfactory, and both reports were adopted. Mr. G. H. Strong was re-elected President, together with Capt. W. E. Dennis, R.C.S., and Mr. Hy. Strong as Acting Vice-Presidents. Mr. W. Nightscales was re-elected Hon. Secretary and Treasurer with Mr. C. B. Snowden as Assistant Hon. Secretary. A ballot for the four positions on the Committee resulted in the following being elected:—Messrs. W. J. Featherstone, Major F. Holman, C. B. Snowden and J. Nicholson. Messrs. T. Forster and T. H. Straker were appointed Hon. Auditors. Other business included the adoption of the bye-laws of the newly formed library which had been framed by the Committee. Mr. Hy. Strong was appointed Hon. Librarian, and for the present the library will be held at the office of Messrs. G. H. Strong & Son, Prudential Buildings, King Edward Street, by kind permission. The offices are open from 9.30 to 5 p.m.; Saturdays, 9.30 to 1 p.m. It is hoped to add further volumes shortly to the library, which is free to all members.

During the evening, Capt. Dennis mentioned that the wireless section of the Northumbrian Signals in Hull would be pleased to send out on their own set one evening per week calibration signals on fixed wavelengths for the benefit of the members of the Society if so desired. This was accepted with thanks, and the Hon. Secretary was instructed to go into the matter with the wireless officer and report at the next committee meeting, when arrangements could be completed and an announcement made to all members.

The concluding part of the evening was devoted to questions and answers, which proved very useful, a large number of members availing themselves of the opportunity of becoming enlightened upon some difficulty or another that was causing them trouble. Fourteen new members were elected, bringing the present membership to over 70.

Mr. J. Nicholson will lecture on Monday, August 14th, on "Accumulators: Their Use and Abuse," when it is hoped there will be a large attendance to hear this important subject.

Meetings of the Society are now held on the second Monday and the fourth Friday in each month at 7.30 p.m., at the Signal Corps Headquarters in Park Street.

**Willesden Wireless Society.**

Hon. Secretary, Mr. G. D. Wyatt, 70, Craven Park, Willesden, N.W.10.

This Society has now recommenced operations, and a meeting was held on July 4th to decide upon the future programme. Mr. F. A. Tuck announced his resignation from the position of Hon. Secretary on account of pressure of business, and Mr. G. D. Wyatt was elected in his place. The Society has now decided as to its future policy. The social side is to be developed. A larger room is to be obtained, and a good receiving set installed. Wireless dances, socials, and demonstrations are to be organised during the winter, and a successful season is expected. Now that the society is in full swing it is hoped that hearty co-operation by all members will assist to make the season a complete success. New members are being especially catered for. The society invites lady members who are interested in radio to join the membership. New headquarters, which it is hoped will be occupied in a few weeks, will have every facility for carrying out the programme, the accommodation being sufficient for about 200 persons. It is announced that T. Illingworth, Esq., J.P., has consented to become President.

**Otley and District Wireless Society.**

Hon. Secretary, Mr. N. Weston, 24, Guycroft, Otley, Yorks.

There was a gathering at Queen's Hall, Otley, on July 27th.

It was proposed and carried that the Club be called "Otley and District Wireless Society.

The following honorary officers were elected:—Mr. A. Woodhead, Chairman; Mr. N. Weston, Secretary; Mr. Preston, Treasurer.

Mr. N. Weston gave a lecture on "Spark Telegraphy" that was well received. Mr. Jones, A.M.I.E.E., kindly lent a four-valve set, and considering that the aerial was only 20 ft. high, and one end on a lamp-post and the other on a ladder, results were satisfactory. Upwards of 30 members were enrolled. Ladies are especially asked to come forward. there are still a number of vacancies open to complete membership to full strength.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"SPARKS" (Birmingham)** *asks* (1) *For a diagram of a two-valve circuit.* (2) *Could he get* **PCGG** *with a two-wire aerial 30 ft. high.* (3) *Could he make a reaction coil.* (4) *What would the inductance of a basket coil be wound with 44 turns of No. 30 S.C.C. wire.*

(1) See diagram Fig. 1. (2) Doubtful, but possible. (3) Yes; a reaction coil is made in exactly the same way as any other coil. (4) The dimensions given for the coil do not appear to be self-consistent. Assuming the number of turns is correct as stated, the inductance would be approximately 300 mhys.

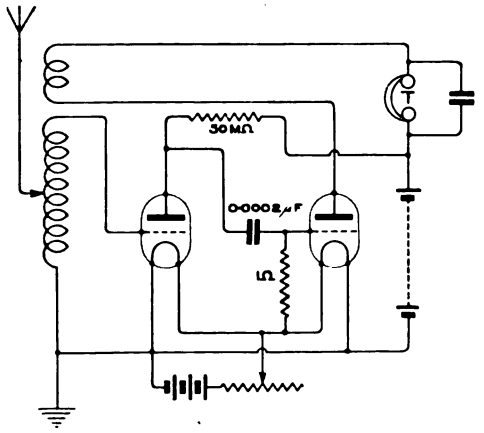


*Fig. 1.*

**"LEARNER" (Walsall)** *asks* (1) *The size and number of plates and the size of spacing washers for a 0·0015 condenser and for a 0·0004 mfd.* (2) *Is a Mullard "Ora" valve suitable for a single valve set.* (3) *Is enamelled aerial wire more efficient than bare copper.* (4) *If 1,000 ohms high or low resistances.*

(1) Plates should be 4" diameter, with 1 m/m between the fixed and moving plate. For 0·0015 mfd. condenser there should be 26 fixed and 25 moving plates. For 0·0004 mfd. condenser seven fixed and six moving plates. (2) Quite good, but not better than various others. (3) Very little better. (4) Too high for efficient low resistance and too low for efficient high resistance.

**"A.L." (Torquay)** *asks if it is possible to receive the Hague concerts and telephony at Torquay with a certain three-valve set.*

Some results might be obtained, but we should not expect them to be very good at such a distance. You might find one or two additional stages of H.F. useful, but reception at this distance will in no case be easy.

**"J.B.B.M." (Bothwell)** *sends diagram of his circuit and asks* (1) *For criticism.* (2) *For dimensions of A.T.I. and reactance coils for use with 0·0004 variable condenser; what broadcasting stations he could receive with an aerial 36' high and 60' long.* (4) *How much wire netting is it necessary to bury at a depth of 3' to form a suitable earth.*

(1) Circuit is quite O.K. (2) A.T.I. about 80 turns with a mean diameter of 2". Reaction coil 50 turns, also with a mean diameter of 2". *N.B.* — On short waves, such as the Broadcasting Band, only approximate windings can be given, as variations in aerial capacity, etc., lead to considerable variations in tuning. (3) The range on broadcasting stations would be approximately 75 miles. (4) Two or three square yards would probably be sufficient.

**"F.P.J.B." (Ealing)** *asks* (1) *To what wavelength will a certain set tune.* (2) *If the set would receive* **2 MT, FL** *on 180 and* **2 LO.** *Should* **CGG** *be heard at all, and what broadcasting stations.*

(1) About 3,500 metres. (2) **2 MT, FL** and **2 LO**, yes. 180 metres and **2 LO** doubtful, and probably only the London broadcasting station.

**"J.D." (S.E.18)** *asks* (1) *Which of four methods of connecting up a valve panel is best.* (2) *Details of certain condenser plates.* (3) *Details of stopping condenser.* (4) *Exact size of foils and number required for a certain condenser.*

(1) We prefer 3 and 4 to 1 and 2. 3 and 4 about equally good. (2) For 0·0003 mfds. one pair of foils overlapping $\frac{1}{2}'' \times \frac{3}{4}''$. For 0·001 mfds. four foils overlapping $\frac{1}{2}'' \times \frac{3}{4}''$. (3) Five foils. (4) Overlap should be $\frac{3}{4}'' \times \frac{1}{2}''$, using ten foils. (It is impossible to give more than quite a rough estimate, as the specific inductive capacity of the mica may vary between wide limits, and the thickness of the sheets will vary from the dimensions given.)



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**"CONTACT STUD" (Rotherham)** *asks with regard to the Reinartz Tuner* (1) *For a diagram of circuit adapted for three valves.* (2) *Could the broadcast signals be heard with this circuit and the loud speaker at a distance of about* 80 *miles.* (3) *Is the length of a receiving aerial still restricted to* 100 *ft.* (4) *Will the Reinartz Tuner tune to any wavelength by means of external coils.*

(1) We have no information on a modification of this set in this way, but think the scheme outlined in the diagram (Fig. 2) should be satisfactory. (2) We doubt if sufficient strength for a loud speaker would be obtained at this distance. (3) We believe that the restrictions are still enforced, but the requirements of the P.M.G. are not finally decided as yet. (4) Yes, up to reasonably high values of wavelengths. We should not recommend this circuit for very long wavelengths above, say, 5,000 metres.

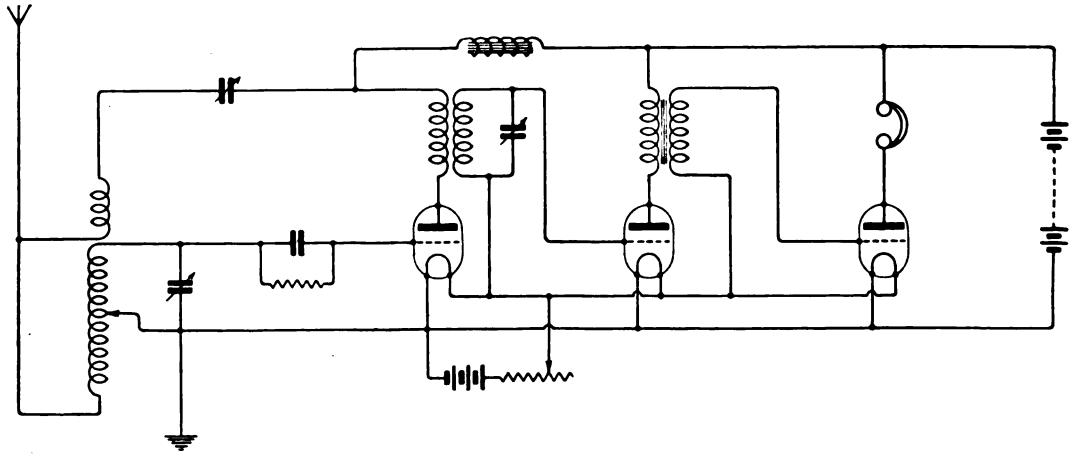

*Fig. 2.*

**"R.C." (Brussels)** *asks* (1) *For winding data for constructing a coil on a phonograph disc.* (2) *Would such a coil do for the reactance.* (3) *If* 400 *ohm telephones be used with an L.F. transformer.* (4) *A formula for calculating the resistance of copper wire.*

(1) A single coil of this nature would not be very efficient. If you use a 12" record and wind it with No. 32, you would get to about 4,000 metres. Put taps in at every half-inch. (2) A similar coil, of about 8" in diameter, wound with the same wire, would be suitable for reaction. (3) No transformer is necessary. (4)

$$R = \frac{4L \times S}{\pi d^2}$$

$L$ = Length.
$d$ = Diam.
$S$ = Specific resistance of copper. $= 2{\cdot}4 \times 10^{-6}$.

} in cms.

**"L.C.E." (Sleaford)** *asks if No.* 38 *wire is thick enough for basket coils.* (2) *Wiring data for a set of basket coils.* (3) *What weight of wire is required.* (4) *If the reaction coil should be larger or smaller than the A.T.I.*

(1) Yes, as a rule. (2) For 250 metres the coil might be 1" internal diameter with 60 turns of wire. For longer wavelengths increase up to 8" outside diameter by 1" internal, two of which, in series, will tune to 3,000 metres. (4) Generally somewhat smaller considering that the A.T.I. is itself very small.

**"E.B." (Charlwood)** *has a two-valve receiving set with capacity reaction, but is unable to receive on a wavelength below* 1,000 *metres and asks how set may be altered so that he can receive* 300/400 *metre wavelengths.*

As you give us practically no information about your set we are unable to say what improvements might be effected, except that increased efficiency at 400 metres could be obtained by usnig a H.F. transformer in place of resistance capacity coupling. A similar effect can be obtained by retaining grid condenser and leak, but using a tuned H.F. circuit in place of the anode resistance.

**"E.J.K." (Portsmouth)** *sends a sketch of his set with which he is having trouble, and asks* (1) *If the aerial is too small.* (2) *If the inductance value is right.* (3) *Should he be able to receive* **2MT** *and* **PCGG.** (4) *For list of stations transmitting telephony, with times, etc.*

(1) No. (2) Rather big, but probably O.K. (3) Difficult with only one valve. (4) **2MT** 8 to 8.30 B.S.M. on Tuesdays (400 m.); **PCGG** 7 to 8 p.m. Thursdays and Sundays (1,070 m.). Other telephony is of an experimental nature at irregular times.

**"H.W.C." (Luton)** *describes his crystal set and asks* (1) *What condensers he will require with their capacities.* (2) *What resistance telephones would be most suitable.* (3) *What is the most suitable wire for connecting.* (4) *The maximum and minimum ranges of set.*

(1) Condensers for each circuit might be 0·0005 mfds. variable. (2) About 4,000 ohms. (3) About No. 20, or flexible cable with about the same capacity. (4) Maximum about 9,000 metres. There are, however, no spark stations working above 3,500 metres. Minimum wavelength uncertain—probably about 600 metres. (The coils are much bigger than necessary.)

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**"A.S.H." (Stoneyhurst)** *asks* (1) *Dimensions for certain windings.* (2) *Where a certain condenser should be used.* (3) *If a telephone transformer is necessary with* 4,000 *ohm telephones.*

(1) Coil A, 12" × 6" of No. 26; reaction coil, 6" × 4", of No. 26. Coil B, 12" × 6" of No. 30. (2) This condenser could be used for the anode circuit. 0·001 mfd. would do for the aerial circuit. (3) No.

**"W.M.R." (Croydon)** *asks* (1) *If a circuit will give satisfactory results on telephony.* (2) *Maximum capacities of various condensers.* (3) *Information regarding his batteries.* (4) *Which of two telephones would give best results.*

(1) No. The circuit is very poor. See the various valve and crystal circuits given in these columns recently. (2) A might be 0·001 mfd., B 0·005 mfd., and D 0·002 mfd. (3) L.T. batteries 6 volts, not less than 20 ampere hours. H.T. 50 volts, flashlamp size, or preferably somewhat larger cells. (4) The higher resistance telephones should be the better. No transformer is necessary.

**"W.J.W." (Gosport)** *asks* (1) *If pancake coils are suitable for telephony.* (2) *What wavelengths could be obtained with certain arrangements of such coils.*

(1) Certainly. (2) You do not give us enough information to enable us to say, as you do not state the diameter of your coils. If the mean diameter of each coil was about 2", the maximum wavelength would probably be 5,000 metres, but 0·005 mfd. is too great a capacity to use for tuning.

**"K.L.E.D." (East Sheen).**—(1) A up to 3,000 metres. B up to 5,000 metres. (2) 0·005 mfd. would be fairly suitable. (3) Reactance should be coupled inside secondary, say 12" × 3½" of No. 36. (4) Impossible to say at all accurately. Probably round about 600 metres.

**"S.J.W." (Keynsham).**—(1) You are correct in assuming that the resistance of the winding of a telephone, or similar instrument, is of no actual use, but serves as an indication of the number of turns which the winding contains. The windings of H.R. telephones are of copper, generally of about No. 47 or 48. Resistance wire is quite useless for the purpose. Inter-valve transformers are generally wound with somewhat coarser wire, say about No. 44, which accounts for the considerably greater size. (2) Finer wires are presumably in closed circuits and in aerial circuits owing to the fact that these closed circuits have in general much less additional resistance than the aerial circuit. Resistance of the wire itself in the closed circuit may therefore be greater without making the diameter excessive. The main object of resistance in a circuit is not so much the direct loss of conductivity for H.F. currents as the damping, and consequent flat tuning which it causes.

**"AUTO" (Enfield)** *asks* (1) *In what cases can receivers of* 120 *ohms,* 2,000, 4,000 *and* 8,000 *ohms be used in wireless telegraphy and telephony.* (2) *What is the advantage of using slab inductances.*

(1) 120 ohms with a transformer can be used for any purpose, and are specially useful in the valve circuits with high voltage valves. H.R. telephones are good for all purposes. The higher the resistance the more sensitive, but the less robust. (2) Slab coils are less efficient, but more compact than solenoid or basket.

**"H.McG." (Lincoln)** *sends a sketch of his crystal set which gives no signals and asks* (1) *Why.* (2) *The wavelength range of coil.* (3) *The wavelength range of set.* (4) *How could he best add a valve to the set.*

(1) We cannot say without test. Everything appears O.K. (2) You do not give us enough information to enable us to say. (3) It should receive ship sets up to 100 miles. (4) Rearrange as in Fig. 2, page 369, issue for June 17th.

**"O.J.L." (Euston Road)** *asks how to add a valve to his set of which he encloses a diagram.*

It is difficult to advise you with any certainty without a knowledge of the internal connections of your set, but the addition of an L.F. valve, as in the diagram (Fig. 3), would probably be satisfactory.

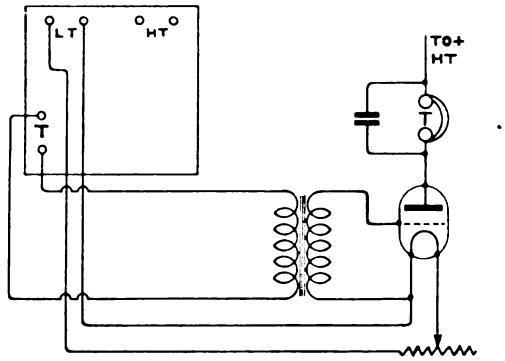


*Fig.* 3.

**"V.B." (London)** *asks* (1) *If a two-valve circuit sketched is correct.* (2) *For criticism of tuning inductance as sketched and maximum wavelength of same.* (3) *If he should get signals with a certain aerial of which he gives particulars.* (4) *The cause of buzzing which he gets, and how to tell when the set is oscillating.*

(1) Correct, but a parallel A.T.C. is not wanted at short waves; also second arrangement sketched is of little utility. (2) Arrangement poor, as it allows too much coupling between the A.T.I. and reaction. Maximum wavelength about 1,500 metres. (3) Aerial very poor, but should give some results. Why not run it out from the bathroom window up to the top of the tree? (4) This sounds like a bad connection in the grid circuit, but we cannot say without test. Oscillation may be detected by howls or muffled and broken up speech and spark reception, or by clicks when the aerial circuit is touched.

**"F.K." (Wimbledon)** *asks* (1) *If a crystal circuit sketched is correct for telegraphy.* (2) *If a valve circuit sketched is correct for the capacity for the variable condenser.* (3) *If copper aerial wire is better than phosphor bronze or silicon bronze.* (4) *If a* 30′ *pump well would make a good earth.*

(1) No. See Fig. 2, page 405, issue for June 24th. (2) This circuit might be used, but is very poor. See many diagrams in these columns for a better one. (3) No, it is not so strong mechanically. (4) Yes, if it has water in it.

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**"BRIAR" (London)** *asks* (1) *If a three-valve circuit is capable of receiving the Dutch concerts.* (2) *For a list of the necessary apparatus to make it.*

(1) See Fig. 1, page 435, July 1st issue. (2) The necessary material consists of:—One coil holder, to carry three valves; set of slab, or honeycomb coils; H.F. transformer; two valve sockets; three variable condensers, 0·0005 mfd.; one condenser, 0·002 mfd.; one grid leak; one L.F. inter-valve transformer; one filament resistance; one L.T. battery; one H.T. battery; one pair telephones.

**"R.W.H." (W.C.2)** *asks* (1) *For a circuit embodying H.F. amplifier and crystal as detector.* (2) *A circuit embodying crystal detector and valve as L.F. amplifier.* (3) *A circuit giving H.F. amplification with crystal detector and note magnifier.*

(1) The use of a valve as H.F. amplifier followed by crystal rectifier can be thoroughly recommended for short wave reception. Suitable circuit is given in Fig. 4. (2) See Fig. 5. (3) See Fig. 6. All of these circuits are admirably suited for your purposes.

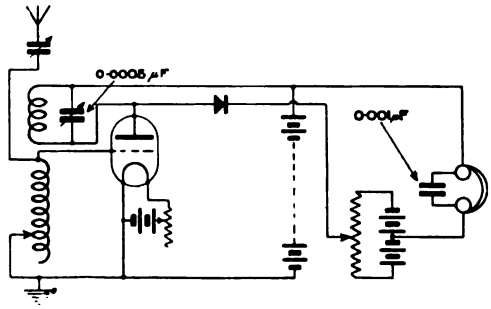


*Fig. 4.*

**"GUNGA" (Edinburgh)** *encloses a diagram of his set and asks* (1) *What should be the capacity of the variable condenser.* (2) *The capacity of the two fixed condensers.* (3) *Resistance of the grid leak.* (4) *Wavelength range of the set.*

(1) 0·0005 mfds., but a series A.T.C. is much better for short wave work. (2) Grid condenser, 0·0002 mfds., and blocking condenser, 0·001 mfds. (3) About 2 megohms. (4) Telephony up to 50 miles, telegraphy from ships up to 100 miles, high power stations further.

**"W.B." (Sunderland).**—(1) Coils should have 80 turns of No. 28. (2) Wind coils 1″ wide of No. 28, sixteen layers with taps at every alternate layer. (3) Difficult to give an average range for a single valve set. Probably 200 miles on ships, Continental high-power stations and telephony within 50 miles.

**"RADIO MANIAC" (Wimbledon).**—(1) 5,000 metres with condenser, 4,500 without it. (2) Yes, provided that the wavelength of the closed circuit is also brought up. (3) Yes, if the dielectric between the plates is not more than 1/4,000″ thick, preferably mica. (4) See Fig. 1, page 90, April 15th issue, and others.

**"W.E.C." (Putney)** *asks if a circuit given to* **"D.F.T." (Lincoln),** *in the issue of June 10th, can be used with a set of "Oojah" coils.*

Yes, quite satisfactorily.

**"E.C.L." (Newark-on-Trent)** *asks* (1) *Why is FL telephony received best with no reaction.* (2) *Which is the better reaction, capacity or magnetic.* (3) *Would an amplifier, designed as per sketch enclosed, work.* (4) *If ebonite for the formers of basket coils is of any special advantage.*

(1) This is a peculiarity of your set. Possibly the sense of your reaction coupling is reversed, or you have some accidental reaction in the circuit besides that due to the reaction coil. (2) There is little to choose, but magnetic reaction is somewhat more stable and controllable. (3) We think the principle involved is quite sound, in fact it approximates fairly closely to that of some commercial semi-aperiodic amplifiers. (4) No.

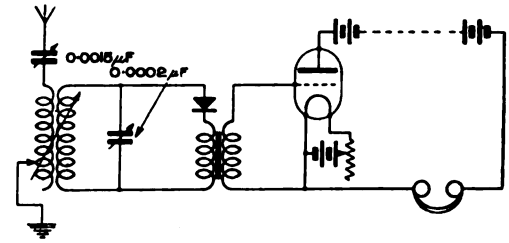


*Fig. 5.*

**"L.C.V." (Southsea)** *sends a diagram of his set and asks* (1) *How to add a reaction coil.* (2) *Size of coils and gauge of wire to tune to 4,000 metres with a 0·0005 mfd. condenser.*

(1) Connect the reaction coil in the plate circuit of the third valve, but it is not at all necessary if you use capacity reactance, as your diagram shows. (2) The coil may be 8″ × 6″ of No. 24.

**"STUCKPHAST" (Rochdale)** *asks the reason for certain noises in his telephones when he touches the aerial terminal.*

We cannot suggest the reason for this behaviour, although possibly your A.T.I. may have a bad connection in it. Try rearranging the leads to the valve as these may be run too closely together. Try also reversing the connections to the reaction coil.

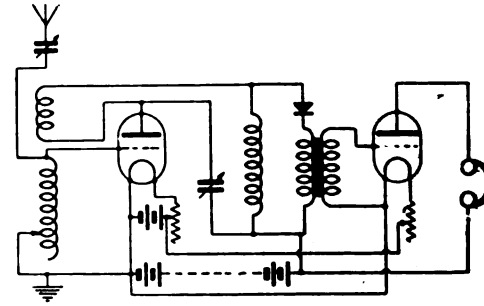

*Fig. 6.*

**"W.H.L." (London).**—The circuit submitted should give quite good results, but we should have preferred one stage of high frequency amplification, and 0·002 mfd. is too high for grid condenser for short waves.

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**"ROGNON" (Rochester)** *asks* (1) *If it is necessary for a fixed condenser to be connected across the telephone terminals of a Reinartz tuner.* (2) *The quantity of wire and length of former for Reitnartz tuner.* (3) *Is an "Ora" valve suitable.* (4) *How to increase the wavelength of his set.*

(1) No, in this circuit it is essential that no telephone condenser should be used. Compare the article in the issue of May 13th issue. This information is given on pages 382 and 383. The length of former may be about 5". (3) Yes. (4) This set is not suitable for very long waves, but the wavelength can be increased somewhat by increasing the number of turns on the coils.

**"S.A.B." (Gloucester)** *encloses a diagram of his set and asks* (1) *For criticism.* (2) *Should we advise alterations to the circuit given in page 438, July 1st issue.* (3) *Which is better for low wavelengths for telephony.*

(1) The circuit is of quite standard type and O.K., except for the fact that it is capable of giving considerable reradiation. (2) The alterations suggested are quite optional. (3) There is very little to choose between them.

**"C.R.W." (Malabar Coast)** *asks* (1) *For a comparison of two transformers.* (2) *If one would be more selective than the other.* (3) *What is the most efficient inter-valve transformer covering a range of 600 to 20,000 metres.* (4) *If potentiometer control of H.T. potential is as efficient as cutting out or putting cells in the circuit.*

(1) The first instrument should give somewhat finer adjustment to correct value, but there will probably not be much difference between them. (2) To cover such a big range several entirely distinct transformers are desirable. (3) No single transformer is efficient over such a large range. Over shorter ranges we are unable to discriminate between the products of our various advertisers. (4) Very wasteful owing to the rapid running down of the battery through the potentiometer resistance, unless this is exceedingly high, which is undesirable from several points of view. Adjustment of H.T. voltage is very seldom required.

**"J.H.E." (County Durham)** *asks* (1) *If it is possible to add one stage of H.F. to a circuit of which he encloses diagram.* (2) *Why does the set howl when the primary switch is off the studs.* (3) *If it is possible to receive* FL *on a three-valve set without an aerial.* (4) *Why he gets signals on a one-valve set and the H.T. switched off.*

(1) See Fig. 4, page 467, issue for July 8th. (2) Owing to the breaking down of the grid circuit the result may be a true oscillation or a sequence of rapid discharges from the A.T.C. (3) It should be possible on an indoor aerial or a good frame. (4) This is not uncommon. Some valves will function without H.T., but in a much less sensitive way.

**"IN DOUBT" (Staines)** *has constructed the American short-wave receiver described in the June 3rd issue, and is unable to obtain satisfactory results, and he asks if the component parts of his outfit are correctly constructed.*

From the information you furnish, and your drawings, everything would appear to be in order, and without describing to some extent what happens when you connect up and attempt to obtain signals, it is difficult to suggest the cause of your trouble. The condenser of the "billi" type is suitable for use with the set, and should be kept for a small value. The direction of winding of the variometer is important, and should be such that when the inner winding coincides with the outer, the two windings are in opposite directions. Reaction effects are obtained in this set by the closeness in the two variometer coils marked in your diagram, B and C. These must be in the right direction one with regard to the other, and you might try reversing the leads which pass from one of the variometers; that is, in the diagram given on page 284, change over the leads that pass to terminal P and one of the telephone terminals; otherwise everything would appear to be in order, and should function correctly. If you care to send us the instrument we shall be pleased to criticise it for you.

**"G.G.S.C." (Pengam)** *asks* (1) *Whether it is better to connect low resistance telephones in series or parallel when operated from a step-down transformer.* (2) *How should a separate heterodyne be connected, and how can he tell if his apparatus is reradiating when using autodyne reception.* (3) *Windings for frame aerial 5" square, to be equivalent in wavelength effect to one consisting of two 70" wires; and* (4) *Which is the better of two circuits, one giving potentiometer control to the H.F. valves and the other to the rectifier valve only, and whether Zenith valves can be used with his set.*

When using a step-down transformer, better results are usually obtained with the telephones in parallel. When high resistance telephones are connected directly in the H.T. lead, they should be in series. (2) To operate a separate heterodyne such as described by Mr. Coursey, it is only necessary to slightly couple the wavemeter coils with the tuning inductance of the receiver. Even the use of a separate heterodyne, if coupled to the aerial circuit, may give rise to slight reradiation. All autodyne or heterodyne receivers when adjusted to the oscillating point, that is when they are capable of the reception of C.W., cause reradiation. The extent of reradiation depends on the potential of the H.T. battery, and consequently the value of the plate current, the type of valve, and the extent of coupling between grid and plate circuits. (3) Use 11 turns of bell wire or single flexible wire. It is not possible to construct a frame aerial that will give a wavelength variation equal to that of a two-wire aerial for a given change of inductance or capacity. For reception over a wide range of wavelength, you might wind on your frame in addition, many turns of single No. 22 D.C.C., and arrange for connecting in or out of circuit by means of switches which obviate dead end effects. (4) Where a number of H.F. valves are used, it is always advisable to arrange potentiometer control for the grids of the H.F. valves, mainly in order to prevent self-oscillation. Separate potentiometer control is desirable for the rectifier valve, which should be of a type specially designed for use as a detector. Your circuit consisting of three H.F. valves, one detector and L.F. valve should be admirably suitable for the reception of telephony and telegraphy. We have no information concerning the type of valves to which you refer.

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**"L.H." (Mansfield)** *is using a three-valve receiver, comprising one H.F., one rectifier, and one L.F. He is not obtaining satisfactory results, and asks us to suggest the probable cause of his trouble.*

There is little doubt that the trouble lies in the design or construction of the intervalve high frequency transformer. The spacing of the primary and secondary windings, and the direction of winding, is important. If you bridge the primary with a small condenser for tuning, it is advisable not to run on the primary and secondary windings simultaneously. If your transformer is wound in a groove, it is as well to wind primary and secondary in opposite directions, taking the finishing end of the inner winding to the plate, and the beginning end of the secondary winding to the grid. We would suggest that you construct a number of interchangeable transformers, experimenting with short-wave high frequency amplification first. Build up a transformer on a piece of 1" ebonite rod, putting on 600 turns for primary, and 600 for secondary, each being single layer and separated from each other by a single layer of empire cloth. If you make these two windings in the same direction, the terminating ends of each winding will be taken to grid and plate. The wire used should be about No. 40 S.S.C. and will be suitable for use on wavelengths between 500 and 700 metres.

**"D. McN." (Dublin)** *has constructed a single valve receiving set with reaction, and is unable to obtain satisfactory results, while his tuning inductance alone works quite well with crystal.*

From your description everything would appear to be in order. The only thing we can suggest is that you might try reversing the connections to the reaction coil. You do not say what circuit you are using, but we think if you were to connect a variable condenser in series with the aerial inductance, and another across the reaction coil, you would probably get oscillations produced, and then the tuning-in of signals will be quite easy. It may be that the wavelength range of the aerial tuning inductance, when joined to your aerial, is not sufficiently close to that given by the reaction inductance.

**"C.J.M.D." (Mill Hill)** *asks* (1) *How much No.* 30 *wire to put on a* 4" *coil to suit an* A.T.1., 5" × 11", *of No.* 24. (2) *Which is the better arrangement, valve as H.F. amplifier with a crystal detector or a single valve used as a detector.* (3) *How many ohms will it take to reduce a current from* 4 *volts to* 2 *volts.*

(1) Wind about 5" length of the tube. (2) The former arrangement. (3) Volts are the measure of electromotive force. A current is measured in amperes. If you will tell us the amount of current flowing we could tell you how many ohms would be required to reduce the pressure from 4 volts to 2 volts, but not otherwise. You should buy an elementary text-book on electricity and study it carefully.

**"N.G." (Barry).**—(1) Use about ½ lb. of No. 26, make coils up to 4" diameter, and connect as many as necessary in series for both A.T.I. and reaction coils. (2) Sliding the coils over each other will be satisfactory. (3) One tap per coil would be sufficient, but probably this will not be essential. (4) 0·001 mfd.

**"ROBBRIDE" (Tottenham).**—(1) Circuit shown is correct, except that a blocking condenser should be inserted across the telephones; also, a parallel A.T.C. is undesirable at short wavelengths. (2) Yes, it is quite suitable. (3) You should receive London broadcasting easily. Dutch concerts only weakly. (4) Any resistance not less than 2,000 ohms.

**"W.H.S." (Sutton-on-Sea)** *gives a list of apparatus and asks if this is complete, and how to connect up the various pieces.* (2) *Is it necessary to have a licence before purchasing apparatus.*

(1) The apparatus suggested would be sufficient, but a grid condenser and leak would be an advantage. Connect up as in diagram Fig. 7. (2) No, but a licence must be obtained before the apparatus is used.

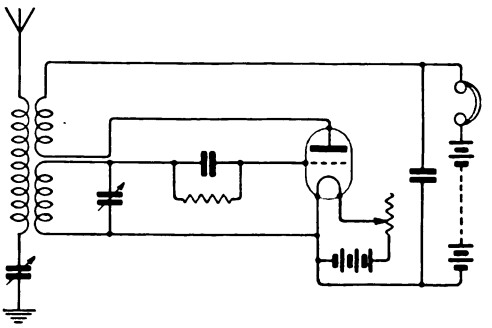

*Fig. 7.*

**"W.H.D." (Hull)** *asks re the American short-wave tuner described in the issue of June* 3*rd* (1) *What resistance telephones should be used.* (2) *Value for the fixed condenser.* (3) *Distance it will receive telephony.* (4) *What transmitting stations work in its limited wavelength.*

(1) Not less than 2,000 ohms. (2) About 0·001 mfds. (3) Perhaps up to 50 miles. (4) Amateur stations about 300 metres and broadcast stations between 350 and 400, but it is not proposed to erect a broadcasting station within 50 miles of Hull.

**"H.K-M." (Newbury)** *asks for certain information in regard to a modified Reinartz tuner.*

Some of the information you require is given in the article on page 445 of July 8th issue. Your former being 9" in diameter, we should suggest the following values: Grid coil 35 turns, tapped at 10, 16 and 25. Aerial coupling 15 turns, tapped at every three. Reaction 30 turns, tapped at every five. This should cover the broadcast band easily.

**"TELEPHONIST" (Llanwrda Caom)** *encloses a diagram of set and asks for suggestions for improvements to enable him to receive broadcasting telephony from all stations in the British Isles, The Hague and Eiffel Tower.*

The circuit shown is quite O.K. except for the anode circuit of the first valve. The grid condenser should be connected on the valve side of the tuned circuit, but some reaction would be advisable and a parallel A.Y.C. is bad on short waves. 300 ohms appears to us excessive for a filament resistance.

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**"J.A.H." (Farnborough)** *asks* (1) *The weight and gauge of wire required to wind the honeycomb coils described on page* 539, *October*, 1920, *issue.*

Use No. 28 wire. 1lb. should be sufficient for all the coils required, which may have turns ranging from 150 to 500. *N.B.*—We regret that, as we have replied to a considerable number of letters from you lately, pressure on our space will prevent us doing so again at present.

**"R.D.M." (Belfast)** *asks* (1) *With reference to page* 35 *of the "Construction of Amateur Valve Stations," how can the secondary* 9″ *diameter fit inside the primary* 8″ *diameter as given.* (2) *If dead-end switches in the secondary coil as well as in the primary will improve the set.* (3) *If a transformer and* 120 *ohm telephones are better than* 4,000 *ohm telephones.*

(1) 9″ should read 7″ and is a printing error. (2) Yes. (3) There is little to choose. H.R. telephones are slightly cheaper and more sensitive, but L.R. are more robust.

**"INTERFERED WITH" (Leicester)** *asks how to overcome interference due to the adjacent tramway system.*

We are afraid we can give you little help as you have tried all the usual remedies. The Leicester tram system is notoriously bad in this way. You might try a directional aerial system as, for instance, one giving a heart-shaped diagram with the blind side to the trams, though we doubt if this would give good results, or H.F. chokes across the aerial circuit; also iron screening of your L.F. circuits.

**"S.S.R.C." (Stoke-on-Trent)** *asks* (1) *The wavelength used for Croydon telephony.* (2) *If he can receive Paris telephony.* (3) *If he can add more valves by means of a "Ford" spark coil used as a transformer.* (4) *The cause of a loud hissing note in the telephones.*

(1) About 900 metres. (2) Possible, but somewhat doubtful. (3) No, the windings are quite unsuitable. (4) We cannot say for certain, but it is probably due to a defective cell in the H.T. battery.

**"J.H.S." (Finchley)** *sends a diagram of his five-valve set, and asks* (1) *For switching arrangement for switching in one to five valves.* (2) *If the diagram is correct.* (3) *If the set can be improved.*

(1) The switching arrangement shown in Fig. 5, page 62, April 8th issue, can easily be extended to suit a five-valve circuit such as yours. (2) Circuit is correct except that blocking condenser in the anode of the third valve should be across the iron-cored coil only, and not reaction coil as well. (3) The set would be somewhat improved by a potential adjustment of the first three valves.

**"H.P.A." (Jersey)** *asks* (1) *For a four-valve circuit to fulfil certain requirements.* (2) *How to alter a certain set for short waves.* (3) *If transformer coupling is better than condenser coupling on short waves.*

(1) and (2) For short wave work we should recommend circuit as shown in Fig. 5, page 62, April 8th issue, with the addition of a further H.F. valve, the switching being extended on the same lines as shown. (3) Yes. (4) A wide range of wavelengths, including short waves. A plug-in arrangement to enable either condenser coupling or transformer coupling to be used is very convenient.

**"G.H.G." (Bedford)** (1) *Refers to the instructions given in the issue of June* 24*th for constructing a buzzer wavemeter to set up oscillations of precisely* 400 *metres, and asks for the dimensions of the condensers and inductances to give* 1,500 *metres and* 2,600 *metres.* (2) *Asks how to add two additional valves to his two-valve set without materially disturbing the present connections.*

(1) The details given in the article referred to were determined by careful experiment, and it is impossible to obtain, by relative calculation, the exact data for constructing these wavemeters. It can only be found by direct experiment and tests against a standard wavemeter. The data was given for 400 metres, for use by experimenters not in possession of a wavemeter. We would suggest that you insert six additional plates in the condenser, which will increase its capacity by four times, and add one extra slab coil to the inductance, wound in the same direction as the one already fitted and spaced ½″ away from it for producing a wavelength of 1,050 metres. For 2,600 metres you might make the condenser with strips twice as wide and twice as long, and by using nine plates you will increase the capacity to sixteen times that given in the article, and this large condenser should be used in conjunction with four slab coils. The utility of this apparatus depends entirely upon precise calibration.

**"C.H.S." (Wolverhampton)** *submits a circuit of a two-valve receiver with high frequency intervalve coupling and a coil coupled to the H.F. transformer for producing reaction effects and wishes to know windings for primary, secondary and reaction coils for this arrangement to tune to* 350/500 *metres.*

When working to this arrangement you are recommended to provide for a moderately loose coupling between the windings of the transformer. The primary which is connected with the plate circuit and bridged by a small value variable condenser (0·0003 mfds.), should consist of 170 turns of No. 28 D.C.C. on a 2″ former, and this should be wrapped at the ends beyond the winding to support the windings on another former at a distance of about ¼″ away. The secondary wound on this outside former should also consist of 190 turns of No. 32 D.C.C. coinciding with the primary winding. The reaction coil can be made to slide outside the secondary and should consist of 200 turns of No. 32 S.C.C.

**"H.C.P." (Birmingham)** *asks* (1) *To what wavelength will a certain coil tune.* (2) *The capacity of variable condensers suitable for the above.* (3) *If he could receive* **2 MT** *and* **PCGG** *with the above coil in a three-valve set.* (4) *If shellacing the wire will affect the coil.*

(1) The primary circuit will receive up to about 5,000 metres without a condenser. Up to 10,000 metres with a condenser as below. (2) Primary 0·001 mfds., secondary 0·0005 mfds. (3) Probably not; the coils are much too big and wound with too thin a wire. (4) It makes it less susceptible to atmospheric changes, and usually slightly affects the tuning range.

**"LEARNER" (Walsall)** *asks for winding details for a set of honeycomb coils.*

Try values as follows, adjusting finally by experiment, but the values you suggest appear very inconvenient. 30, 40, 70, 85, 150, 250, 550, 650.

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**"KO SINE" (Whitehaven)** *asks how H.F. currents are changed into L.F. currents.*

An adequate discussion is out of the range of these columns and we should advise you to buy a book such as Bangay's "Elementary Principles," which will give you some idea as to the wireless theory. As you suggest, the valves used for H.F. and L.F. amplification are the same, and generally the same valves are used for rectification. The difference in action is in each case due to the circuits employed. Very roughly speaking, the large number of H.F. pulses of current corresponding to each spark are passed through a rectifier, which may be a valve or crystal, by which all the negative half-cycles are wiped out. The series of positive half-cycles, if passed through a high impedance, such as an iron-cored transformer, behave as one L.F. pulse through the transformer.

**"ANDREAE COLLEGIUM" (Bradford)** *asks (1) How to add another valve through a resistance capacity to a circuit sketched, so that he can switch over quickly from one valve to two. (2) Whether English broadcasting stations could be heard on one valve at Rouen.*

(1) Use a spherical reaction coil. Preferably couple the switch shown with a switch to break the filament of the second valve (Fig. 8) when not required, and use separate filament resistances for each valve. (2) Very doubtful.

**"A.W." (Plumstead)** *encloses a diagram of circuit and asks (1) For criticism. (2) Capacities of condensers suitable for the set. (3) Wavelength of set.*

(1) Not very efficient. We prefer the circuit of Fig. 3, page 501, issue July 15th. (2) Closed circuit condenser 0·0005 mfds., grid condenser 0·0002 mfds. (3) Wavelengths up to 4,500 metres with an additional aerial loading inductance. Without this only up to about 2,700 metres.

**"READER" (Royston)** *refers to Fig. 7, page 276, May 27th issue, and asks (1) The capacity of the reaction condenser. (2) If honeycomb coils are suitable for coupling the valves. (3) If he is infringing any patent by selling a receiver using this circuit.*

(1) Up to about 0·0001 mfds. (2) Not very suitable, but something might be done with them in special circumstances. (3) We believe that capacity reaction as well as magnetic is covered by existing patents.

**"J.S." (Byfleet)** *wishes to know (1) and (2) How to arrange a "B Mark I" set for short wave reception. (3) The wavelength range of his tuner, wound with 92 turns of No. 24 D.C.C. on 4" former for primary and 175 turns of No. 36 D.C.C. on 3" former for secondary.*

(1) and (2) See December 10th, December 24th and January 7th last issues. (3) When connected to a single wire aerial 100′ in length, the maximum wavelength to which the set will tune will be approximately 900 metres. For telephony reception we recommend you to construct two special coils, the exact dimension of which can easily be found by experiment, specially suitable for use on your aerial.

**"FINE ADJUSTMENT" (Douai School)** *asks with regard to a Reinartz tuner he is constructing (1) If the wavelength depends on the aerial or grid circuit, and how to calculate the dimensions of the coil. (2) How can another valve be added to the tuner for H.F. amplification. (3) Would such a set with a 100′ × 60′ high aerial receive 2 NT and PCGG at Addlestone, Surrey. (4) If a crystal detector can be used with a Reinartz tuner.*

(1) Chiefly on the grid circuit. About 5" × 4" of No. 20, with 0·0005 mfd. condenser will be O.K. (2) See the article in the issue of July 8th. (3) Probably. (4) Not efficiently.

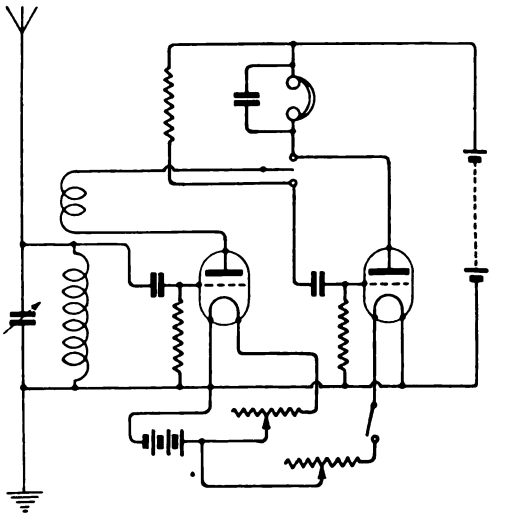

*Fig.* 8.

**"A.M.H.C." (Shoreham)** *asks re reaction coil on page 33 in Alan Douglas's book, how many tappings are necessary, as the diagram shows five and the letterpress stipulates 34. (2) If an illustration can be given showing the attachment of the reaction coil. (3) For a sketch of the circuit.*

(1) Apparently 34 were intended, as page 33 distinctly says that it is the secondary taps which are visible in the illustration. 34 is, however, rather a large number. (2) We think the letterpress gives a very fair description. One or two rods are passed right through the cheeks of the inner coil, and are arranged so that this coil can slide on them. The rods are fixed in any convenient way parallel with the base carrying the primary coil. The coupler may be used in the circuit of Fig. 4, page 11, or in many of the circuits given in these columns.

## SHARE MARKET REPORT.

Prices as we go to press on August 4th are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 3 | 0 |
| ,, Preference .. .. | 2 | 0 | 7½ |
| ,, Inter. Marine .. .. | 1 | 8 | 0 |
| ,, Canadian .. .. | | 10 | 0 |

Radio Corporation of America:—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | | 19 | 3 |
| Preference .. .. .. | | 13 | 9 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
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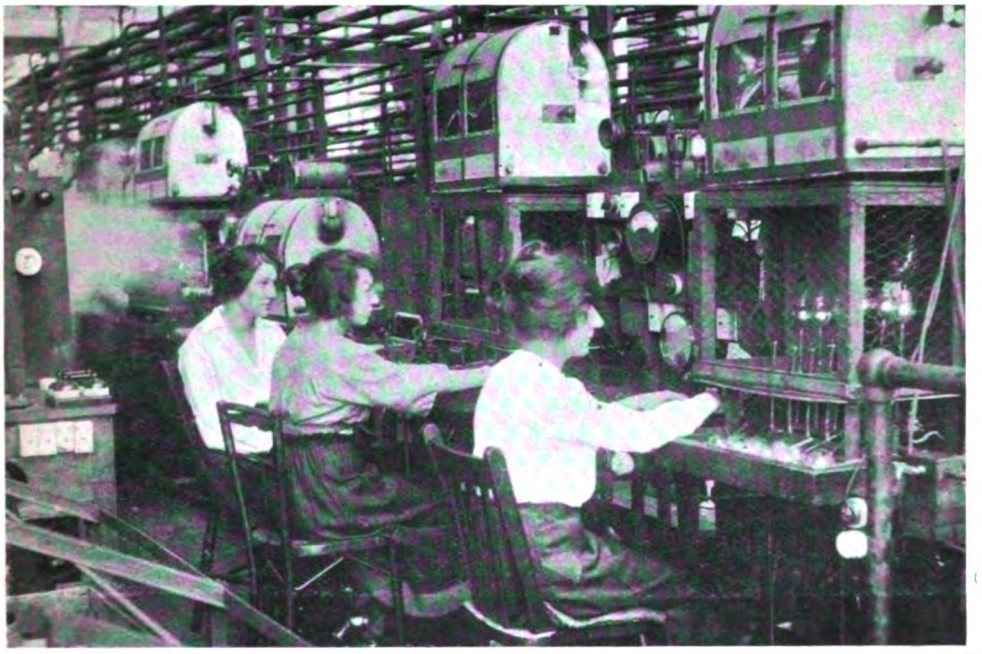
VOL. X. No. 21. AUGUST 19TH, 1922 WEEKLY

## Valve Manufacture

### A BRIEF DESCRIPTION OF THE SIMPLER PROCESSES ADOPTED IN THE MANUFACTURE OF M.O. VALVES

NOW that valves are so extensively used for transmission and reception, and by their use the production and detection of continuous waves and the transmission of telephony are rendered possible, it is perhaps surprising that so little information is available dealing with the manufacturing processes adopted in this new industry.



*Valves of the "R" type connected to the pump whilst the operator controls the potentials applied to the electrodes.*

Before describing the methods of manufacture, an explanation of the term "M.O." may be given. The inception of the present company for manufacturing valves, which carries on business at the Osram-G.E.C. Lamp Works, Hammersmith, is due to a combination of the experiences of Marconi's Wireless Telegraph Company, Ltd. and the General Electric Company, Ltd., who have combined together the valve business and manufacture under the title of the M.O. Valve Company, Ltd.

The first consideration in valve production

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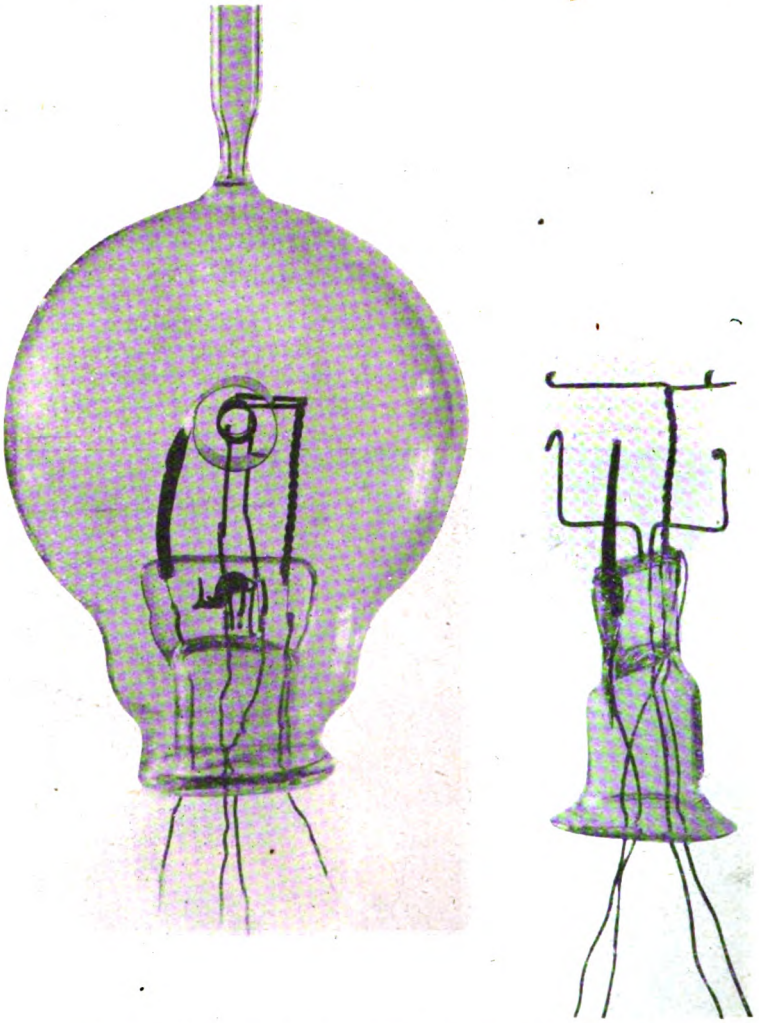
is the selection of materials having suitable properties. The glass is supplied by the glassworks in the form of bulbs, tube and rod, of such dimensions and shapes as are required. Its composition must be such as will render it suitable for the particular service in which it is to be employed. The nature and composition of the glass is of the greatest importance, and successful valve manufacture is largely dependent upon this. The essential features, particularly with respect to transmitting valves, are that bulbs and tube shall have a uniform thickness of wall, a high softening temperature, and high non-conductive properties at moderately high temperature. If these conditions are not met, serious trouble will arise, due to electrolysis and the liberation of gas, which will either prevent a good vacuum from being obtained or else result in the rapid deterioration of valves through poor vacuum after they have been put into service.



*The "R" Valve. Left. Ready for preliminary pumping. Right. Foot tube with electrode supports.*

The various metals employed in valve construction must also be of the highest degree of purity, and capable of being effectively gas-freed. Nickel is at present almost exclusively employed in anode construction,

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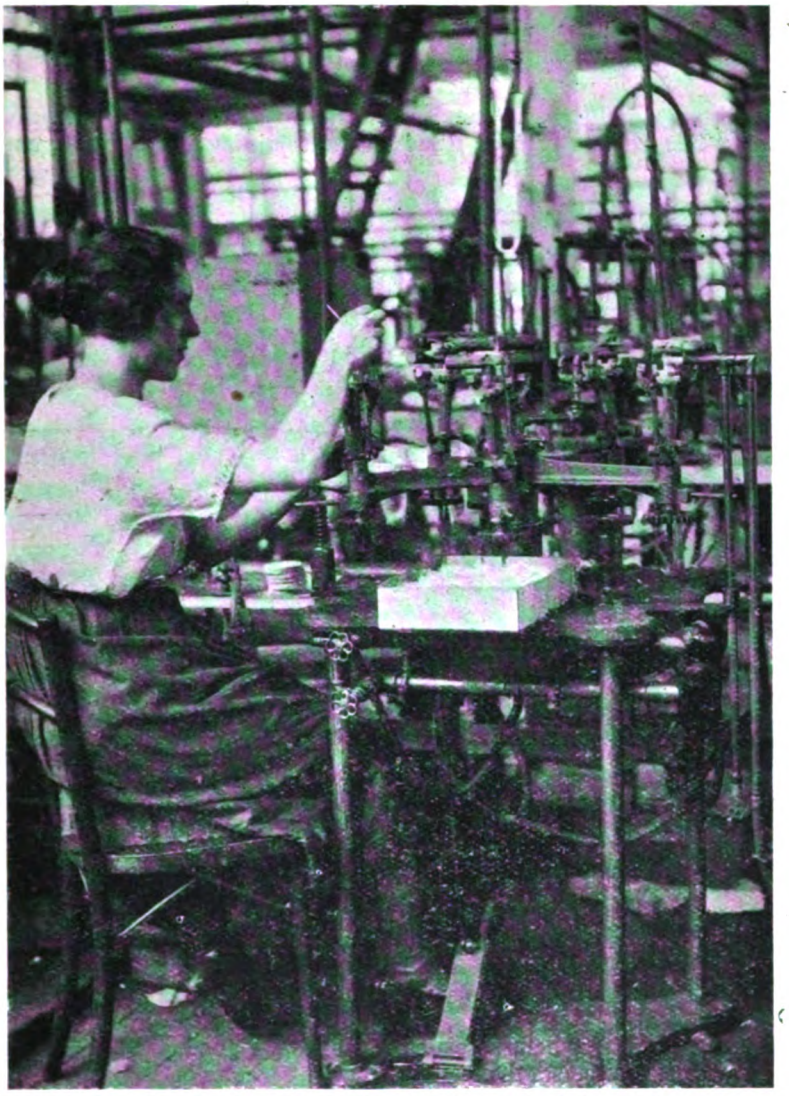
and is supplied in rolled sheets of the thickness of 0·2 mm., in the form of wire and flat strip. Nickel is also used for making the supports for the electrodes, though under special circumstances molybdenum, or "nichrome," is to be preferred. Molybdenum is not so soft as nickel under heating, and consequently makes a stiffer support. Nichrome is almost as good in this respect, and has a further advantage in the fact that it can be more easily gas freed. Platinum is used solely for making a vacuum-tight seal where the electrode leads pass through the pinch, which is that part of the valve at which the electrode connections enter, and in the case of small receiving valves forms the point of attachment for the electrode supports.

In all valves, one or more of the electrodes is supported from a flanged glass foot tube, which is subsequently welded to the neck of the bulb. Foot tubes vary considerably in size and type, dependent upon the form of valve in which they will be used.

In the case of receiving valves of the ordinary



*Machine for clamping electrode supports and leads in the foot tube.*

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type, such as the "R" valve, the foot tube is prepared from a short length of suitable glass tube, cut to a predetermined length. One end is heated and spread out in the form of a flange. The wires that are to pass through the foot tube are first cut to the required length, each complete "wire" consisting of three parts welded together, the external leads being of copper. The part that is to form the seal is of platinum, and the internal support of nickel, molybdenum or nichrome as the case may be.

Welding is done by means of a fine hot blowpipe flame. The copper wire is fused directly to the platinum strip; the other end of the platinum strip, after having a small amount of copper fused to it, is welded to the nickel.

It is, of course, necessary, before sealing in, to thoroughly clean the whole of the interior metallic parts of the valve, to remove from their surface all impurities which may have accumulated through constant handling in the course of manufacture, and further they must be gas-freed as far as is possible before the actual bombardment to which they will subsequently be subjected during exhaustion. These operations are carried out in a vacuum furnace, the wires referred to, together with the other parts, being packed in a nickel tray. The furnace has a fused silica heating chamber in the form of a tube. After the internal metallic parts have been thus treated, they are placed in the foot tube on a machine which rotates in front of a series of blowpipe flames, and when sufficiently hot, two flat jaws are brought up and completely embed the wires in the glass in their correct position relative to each other.

In the case of special valves and many types of transmitting valves, the arrangement of the "pinch" cannot be conveniently accomplished by machine methods, and has to be largely effected by hand. In such valves the two filament leads usually share the same pinch, whilst the anode and grid leads may each have a separate one. The effect of electrolysis in this connection is that owing to the high temperature the glass becomes conductive, and current passes between the electrode leads in the pinch, with the consequent liberation of gas from the glass. In the case of valves of very high power, such as will be operated by voltages of 10,000 or more, the method of

*An assembling bay, where filaments, grids and plates are fitted.*

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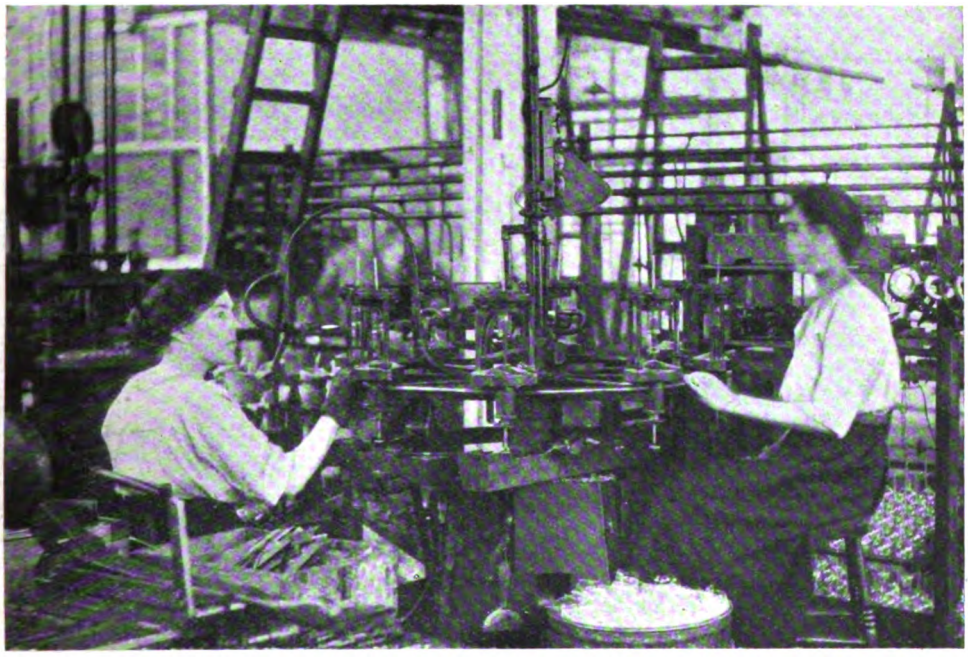
bringing the grid and filament leads together through the same foot tube cannot well be employed, and so in valves of this type the three sets of leads are kept as far apart as possible. The anode lead is taken from one foot tube, the filament leads through the opposite one, and the grid lead through an additional sealing tube in the bottom of the bulb, but as this part of the bulb is more liable to metallic deposit than the necks are, it is essential that precautions be taken to ensure perfect insulation between this deposit and the grid lead.

In the case of small valves, the grid is kept straight and the spacing correct by lacing it to a stiff support called a " damping wire," having two loops or eyes made in it, and spaced the correct distance apart, corresponding to the total length of the finished grid. The ends of the damping wire are afterwards attached to the vertical grid support wire, which is mounted on the pinch. To prevent vibration in use, the individual turns of the grid helix are each bound to the damping wire.

Grids for larger valves require more than a single support. In such cases three support wires are laid along a mandrill in which a light screw thread has been cut. The grid is wound over the supports, and the operator sews each turn to each of the three supports, using for the purpose a needle threaded with fine molybdenum wire, and making the helix follow the screw thread on the mandrill. After lacing, the end turns may be arc-welded to prevent slipping. Close-meshed grids are cut to size, and after being bent to the required shape, the ends are stitched together with molybdenum wire. Some forms of grid are open-ended, while others have the top end



*Machine for sealing in the mounted electrodes.*

There are two types of grid, one composed of a wire wound into a helix, the other being of wire mesh formed into a hollow cylinder. The helical grid is used when liberal spacing is required, while mesh is more suitable, and also more convenient from a manufacturing point of view, for valves in which close grid spacing is required. A mandrill is made having a diameter equal to that required for the grid, and on this the wire is wound in a long helix. The overall length of each grid is predetermined, and the number of turns which it shall have per centimetre, and also the number of turns in that length.

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entirely closed. The former are used in low power valves which are not intended to operate on very high tension circuits, and they have

*Detector Valve, Type R.4.B. Filament volts 3·8, filament amps. 0·65. Normal anode volts, 50/70. Designed for use as a detector or low frequency amplifier.*

the loop end of the filament supported by a wire which may be fixed to the grid foot tube, or it may terminate in a closed stud, forming part of the anode foot tube at the other end of the bulb, and designed to ensure good insulation between the anode and filament.

Grids with domed ends have a small diameter opening left in the centre, into which is fitted a flanged button of highly insulating, heat-resisting material. This has a small diameter hole through its centre, through which the filament tension wire passes to a spring. As previously stated, nickel is generally used for making valve anodes. Blanks are stamped out in the various sizes required, and formed up into cylinders by rolling them round mandrills. Anodes of small receiving valves are plain cylinders having a projecting tongue which is afterwards arc-welded to the anode support wire, which is satisfactory, owing to their small size and weight. With larger valves a tripod arrangement is adopted, the anode being blanked out and holes punched for rivetting to three support legs. Large anodes are stiffened by rolling ribs round them, and in some cases by also turning the edges over.

The valve filaments are all of drawn Tungsten wire, but there are some slight differences between the wire used for receiving valves and that for transmitters. The filaments are accurately cut to size on gauges and jigs, and the correct mounting position located by means of a sharp bend, so as to ensure correct length between support points. Filament wires are thoroughly cleaned before they are sealed in, so as to remove from their surface all impurities, by being heated

*Low Temperature Emitter, Type L.T 3. Requires a filament potential of only 1·8 volts and passes a current of 0·11 amperes. An efficient detector, oscillator, high and low frequency amplifier.*

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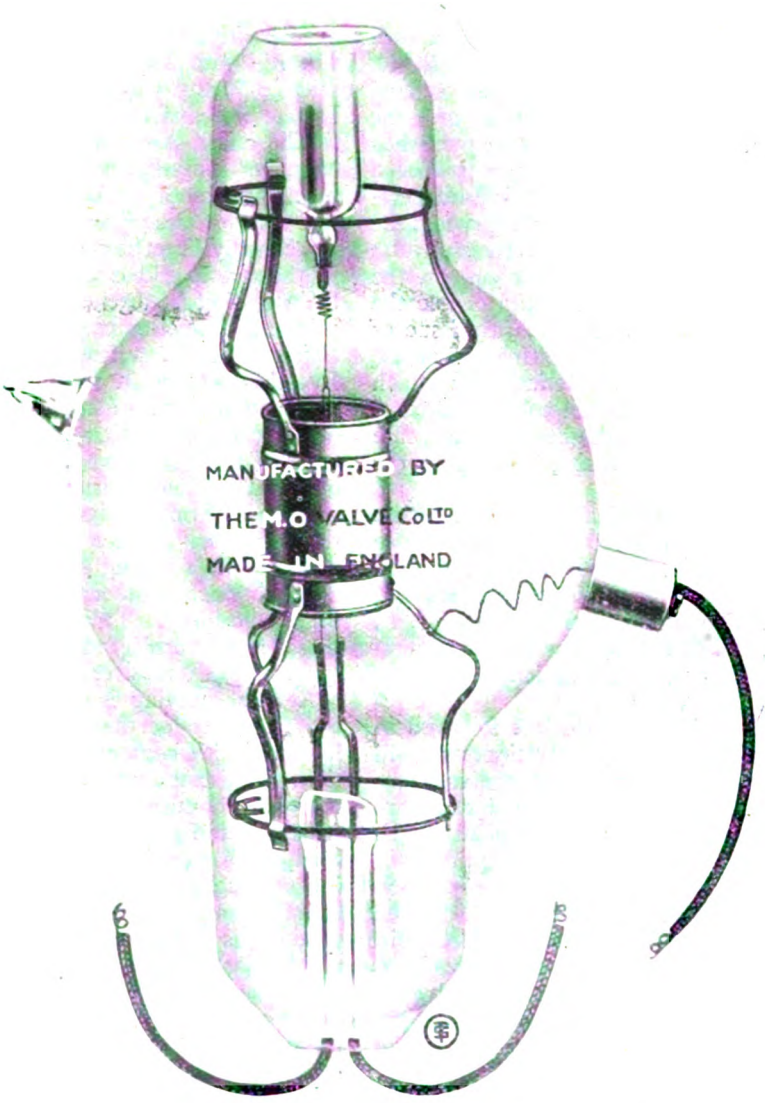
in dry hydrogen to a bright red heat. This treatment not only cleans the surfaces, but removes springiness and kinks from the wire. tungsten, and good electrical contact ensured. The projecting ends of the filament may in special circumstances be bent back and arc-




*A Power Rectifier, Type U.100.*

The mounting of the filament is effected by first flattening out the ends of the supporting wires by pliers having specially shaped jaws. The hooks are then tightly pinched over the welded to the supports, an operation which requires considerable skill.

(*To be concluded in issue of 26th August*, 1922.)

B

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# More about the Armstrong Super-Regenerative Receiver

THE article which appeared in our issue of July 29th regarding E. H. Armstrong's new circuit has created widespread interest. That article was the first information on the subject to be published in this country, and as that was prepared in haste from the very little practical information divulged by Mr. Armstrong when he described the apparatus before the Institute of Radio Engineers, it does not contain the practical information which would enable the circuit to be tried out. In the July issue of *The Wireless Age* there appears an article which gives some more practical data which may at least serve to help in solving practical difficulties which no doubt amateurs are experiencing in endeavouring to operate the circuit.

We give below an abstract of the article appearing in *The Wireless Age*, and this we hope to follow in an early issue with a detailed description of how to build up the set and operate it. The author of the article, Mr. A. Ringel, opens up the subject with a consideration of the theory of regeneration.

THEORY OF REGENERATION.

Before describing the principle involved in this new extension of regeneration, we will consider the behaviour of an ordinary regenerative receiver. Incoming signals are applied between the grid and filament of the valve. These oscillations are amplified in the valve, and as a result, we get very much greater variations in the plate circuit. If the plate circuit is coupled back to the grid circuit, the reinforced oscillations are fed back to the grid and are once more re-amplified by the valve. In this way we can build up a very weak signal until it is of sufficient amplitude to give a loud sound on detection.

This process is called regeneration. The amount of amplification is controlled by the coupling between the grid and plate circuits. In the case where a reaction coil is used in the plate circuit, the extent of regeneration depends on the magnetic coupling between the reaction coil and the grid coil. Where a variometer is employed in the plate circuit, the coupling is capacitive, due to the capacity between the grid and plate of the tube itself, and the magnitude of this coupling is determined by the value of the variometer inductance.

The effect of regeneration is to reduce the effective radio-frequency resistance of the receiving circuit to a very low value. This the operator can prove to his own satisfaction by actually inserting several hundred ohms in the tuned grid circuit. He will find that by increasing the regenerative coupling between grid and plate circuits, he will obtain the same signal as if the resistance were not present. In other words, in regeneration we have a powerful method of annulling the resistance of a receiving circuit. In this way it can be reduced to as low as a few hundredths of an ohm. This low resistance accounts for the sharpness of tuning obtained on a regenerative receiver—very often a variation of only half a degree on a tuning knob is enough to lose a signal which is otherwise of several hundred times audibility. This helps to explain the presence of vernier adjustments on all good types of such receivers.

As the coupling is increased still further, the resistance of the circuit is lowered and lowered, with consequently greater amplification. When the resistance approaches zero, the valve commences oscillating at a frequency determined by the tuned circuits. These oscillations are identical to those obtained in continuous wave transmitters, except that they are much feebler. Although the signal received is very much louder, its quality is entirely lost. If it is a spark note, it becomes hoarse and mushy, losing its characteristic note—and speech and music, although their presence is apparent, become absolutely unintelligible gibberish. If no signals are coming in, the presence of oscillations can be detected as follows :—

1. As the regenerative coupling is increased to the oscillating point, a sudden rushing or hissing, is heard in the phones.

2. Touching the grid terminal of the valve with the finger will produce a dull thump in the phones—and removal of

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the finger will cause a similar thumping noise.

THEORY UNDERLYING SUPER-REGENERATION.

As explained before, much greater signal strength is obtained when regeneration is increased—but this is all upset when the valve breaks into oscillation. In his super-regenerative circuit, Armstrong increases the coupling so that the valve is far beyond the oscillation point, and the effective resistance of the circuit is made even less than zero—the circuit is made to have a negative resistance. And he stops the oscillations so that he can take advantage of this negative resistance and thus obtain powerful signals.

Before going any further, let us diverge a bit and delve into the theory of various tuned circuits containing (1) positive resistance, (2) zero resistance, and (3) negative resistance. In the first case, when continuous oscillations are impressed, after a short building up time, the oscillations attain and preserve a definite constant amplitude. When the impressed oscillations are removed they die away to zero. The greater this resistance, the longer it takes to build up the oscillations and the faster they die off—and *vice versa*. In the second case, when continuous oscillations are impressed, they keep on steadily increasing in value, depending on how long they are applied. If the source of oscillations is removed, the circuit keeps on oscillating at the same amplitude it had when the voltage was removed.

In a negative resistance circuit, if oscillations are applied, they continue building up to an extremely great value, regardless as to whether the voltage is removed or not. However, at any given time after the e.m.f. is impressed, this amplitude, although very large, is always proportional to the initial applied amplitude. Thus, if we have continuous waves modulated by speech or music applied, the amplitude will be proportional to the actual amplitude of the speech waves at the moment of application. No matter how small this initial voltage is, it will at once commence to build up to an infinitely large value. So much for pure theory. In actual practice, if we go to the negative resistance circuits, we cannot secure the above results, because the circuit breaks into oscillation at the slightest shock, thus paralysing the tube.

THEORY OF THE SUPER-REGENERATIVE CIRCUIT.

Armstrong takes advantage of regeneration to the limit of a valve, and still prevents it from oscillating. He has discovered that he can stop oscillations in a negative resistance circuit either by introducing resistance in the circuit at definite intervals or by reducing the amount of regeneration so that the circuit resistance becomes positive and negative alternately. In both cases the effect is to give the circuit first a positive and then a negative resistance. This alternation is sufficient to prevent oscillations. During the negative resistance period we can make full use of the very great amplification produced—but just as the circuit is about to start oscillating of its own accord, we introduce a positive resistance. During the positive resistance period, the circuit, of course, cannot oscillate and the resulting amplification of the incoming signals is much less than before.

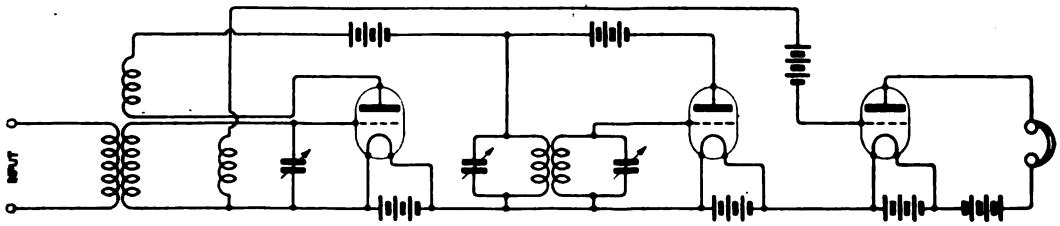

*Fig. 1. Control of regeneration by varying the H.T. supply.*

This variation between positive and negative resistance may be made at any frequency desired, provided that it is less than that of the incoming oscillations. No doubt it could be done mechanically by connecting a resistance in the tuned grid circuit, regenerating beyond the oscillation point, with the resistance short circuited, and then alternately short and open circuiting the resistance at any desired frequency. Variation in regeneration may be accomplished in a similar manner by mechanically varying the plate voltage of the regenerating valve so that the grid circuit



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resistance is alternately positive and negative. Then again, we may use a combination of both methods.

But moving mechanical parts may be dispensed with and vacuum tube oscillators employed to produce this variation in circuit resistance or amount of regeneration. These methods are illustrated in the diagrams.

### SUPER-REGENERATION BY PLATE VOLTAGE VARIATION.

Fig. 1 shows how the amount of regeneration is varied by varying the plate voltage. The first valve is the regenerator, which introduces negative resistance in the grid circuit. Incoming signals are coupled to the grid circuit, amplified in the first valve and fed back to the grid by means of the reaction coil. The reaction coupling is made large enough to carry the circuit beyond the oscillating point. The second valve acts as oscillator of any frequency desired. Generally, one of about 10,000 cycles is suitable. The amateur and experimenter will recognise the usual oscillating circuits. The coils and condensers should be so selected as to give this frequency (which corresponds to a wavelength of about 30,000 metres).

Note that the plate oscillatory circuit is also in the plate circuit of the first valve. The plate voltage of this regenerating valve is thus varied at a frequency of 10,000 cycles. When the oscillations are such as to make the plate more positive, regeneration is increased beyond the oscillating point, and the signal amplitude increases to a very great value. Just as the valve is ready to burst into oscillations of the circuit frequency, the applied frequency reduces the plate voltage to a low value, and thus reduces regeneration and introduces a positive resistance in the grid circuit—effectually cutting off any sign of free oscillation. A very high degree of amplification is thus obtained during those half cycles of the 10,000 cycle oscillations when the plate is made more positive.

The grid circuit of the first valve is coupled to an aperiodic coil in the grid circuit of the last valve, which acts as a detector. Rectification is accomplished by applying a negative potential to the grid, instead of the usual condenser and leak. But it is really immaterial which method is used. The first valve may be an amplifying valve. But it is desirable, though not essential, to have power valves for the oscillator and detector, because of the energy they are required to handle. For the receiving circuits, the coils and condensers should be of values suitable for tuning to the wavelength range desired. In the oscillatory circuit, the coils should be quite large—with an inductance of the order of 100 or 200 millihenries. (Honeycomb or duo-lateral coils No. 1250 or 1500, approximately.) Pie-shaped coils used in spark transformers, having 1,500 to 2,000 turns, are suitable here. The condensers are ordinary 43 plate variable air condensers.

The system shown in Fig. 1 should present no great difficulty in operating or adjusting. The condensers and coupling in the oscillator are adjusted until a very high pitched whistle is obtained. Then the receiving and regenerative circuits are tuned to the station to be received in the usual manner. In fact, the operation should be much easier than that of the average receiver.

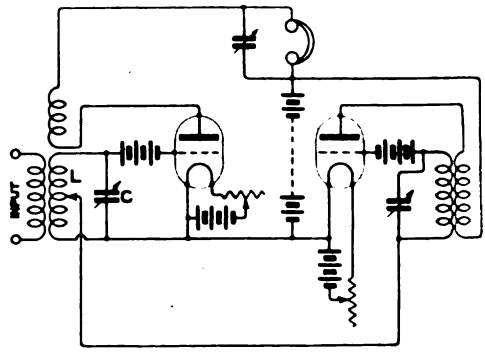


*Fig. 2. Control by positive resistance in the grid circuit.*

### SUPER-REGENERATION BY RESISTANCE VARIATION.

Fig. 2 shows a method whereby a positive resistance is introduced into the tuned grid circuit of the regenerating valve. Incoming signals are applied to the grid of the first valve and amplified by regeneration due to the reaction coupling. The second valve acts as a 10,000 cycle oscillator—and these oscillations are also impressed on the grid of the first valve. The regeneration is carried beyond the normal oscillation point of this valve. During that half cycle, when the local oscillations make the first grid negative, no grid current is drawn and the effective radio frequency resistance of the circuit is negative

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because of the super-regeneration. The incoming signal is built up to very great amplitude during this interval. Just as the first valve is ready to go into oscillation, the local oscillations are reversed and tend to give the first grid a positive potential. In this case, a stream of electrons commences to flow from the filament to the grid and this is equivalent to connecting a resistance of several thousand ohms across the tuned circuit. The effective resistance of this circuit is thus increased until it is no longer negative, but positive, and thus chokes out free or self oscillation in the receiving circuits. Of course, we obtain very high amplification in the negative resistance periods. In the circuit shown, the first valve acts as the detector. Evidently Armstrong prefers to use a grid cell instead of condenser and grid leak to obtain rectification.

circuits are used to produce the necessary 10,000 cycle oscillations. The condensers $C_1$ and $C_2$ should be of fairly large capacity, say 0·001 microfarad, in order to provide a by-pass for the incoming high frequency signals—since the latter would be blocked by the high inductance coils $L_1$ and $L_2$ (of about 200 millihenries each).

The received signals are super-regenerated as usual during that interval when the 10,000 cycle oscillation applies a negative potential to the grid, and at the same time tends to increase the effective plate voltage. The oscillations in the grid and plate circuits must be of the proper phase, so as to produce both the above effects at the same time. During this half cycle, the effective resistance of circuit L C is made negative, resulting in considerable regenerative amplification. Just

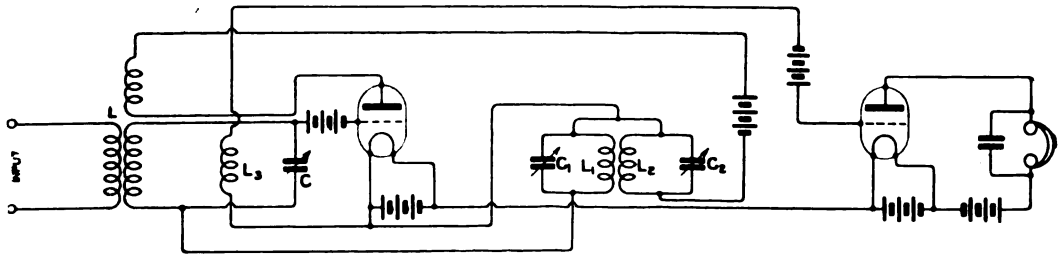


*Fig. 3. A combination of the methods shown Figs. 1 and 2.*

Only two valves are used in this arrangement, the first performing two functions, regenerator and detector, the other acting only as an oscillator. Since the only thing that controls the amount of amplification is the limit of the valve, better results could be obtained by using power valves instead of ordinary receiving valves in cases where extraordinarily great intensity is required.

### Super-Regeneration by Combined Resistance and Plate Voltage Variation.

Fig. 3 shows a method of varying the resistance in the tuned grid circuit and plate voltage simultaneously.

The circuit L C is tuned to the incoming signals and these are impressed on the grid of the first valve—the signal being amplified by regeneration in the manner described above. In series with L and C, we have another tuned circuit $L_1$ $C_1$ coupled to $L_2$ $C_2$, which is in series with the reaction coil. These

as L C is on the verge of self oscillation, the polarity of the applied 10,000 cycles reverses, so that the grid is made positive and the plate voltage is lowered. The former causes grid current to flow, thus introducing positive resistance. The resuction in plate voltage decreases the amount of regeneration and thus aids in increasing the positive resistance. Under such circumstances, of course, free oscillations are completely choked off.

In this arrangement, both regeneration and 10,000 cycle oscillation are performed within a single valve. A second valve, the grid of which is coupled to L, acts as the detector. The adjustments both for tuning and local oscillation are very critical. Hence this circuit is not suitable for use by the average experimenter because of the great pains necessary in order to secure super-regeneration.

### Practical Super-Regenerative Circuit.

Fig. 4 shows a practical two-valve circuit.

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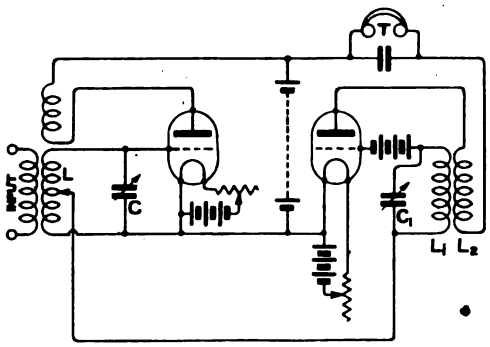



*Fig. 4. A practical two-valve circuit.*

It is essentially the same as that of Fig. 2. The first valve is the regenerator and the second the local oscillator. Free oscillations in the receiver circuit are stopped by those half cycles of the local oscillations which make the first grid positive.

The unusual feature in this arrangement lies in the use of the oscillator valve as the detector of the signals which are amplified by super-regeneration by the first valve. The amplified signals are impressed upon the grid of the oscillator valve, which rectifies them, in the plate circuit, thus making them audible.

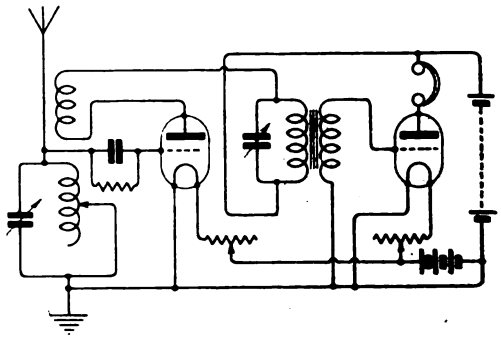
# An Amateur-Made Two-Valve Set in Buckinghamshire

By A. F. H. BALDRY.

WHILE nothing out of the ordinary is claimed for this set, either in design or results accomplished, it is thought that this description may be of interest to fellow amateurs in the fascinating hobby of wireless.

The apparatus consists of one rectifying and one note-magnifying valve with L.F. transformer mounted on an ebonite panel measuring 11 ins. by 9 ins. and enclosed in a polished wooden cabinet 11 ins. by 9 ins. by 4½ ins. With the exception of the usual items, L.F. transformer valves, phones, etc., the set is entirely amateur-made. There are two sets of inductances incorporated, together with reactances, which are so connected with a four-pole switch that either may be used at will. The inductance formers both measure 3 ins. diameter, and were made of ebonite with reactances measuring 2½ ins. diameter, arranged to turn within. The set being divided into two sections, it was found that by making six tappings in the short wave inductance, an effective range of 200 metres to 1,000 metres was available. Each tapping was brought out to a brass contact stud turned up out of the solid. A similar process was adopted with the long wave inductance, twelve tappings being made in this instance. This gives an approximate range of 1,000 metres to 12,000 metres. Each valve is controlled by a separate filament resistance which are both mounted on a small ebonite panel measuring approximately 4 ins. by 2½ ins. let into the centre of the front side of the cabinet.

The long wave reactance has two tappings brought out and controlled by a small switch



*Circuit Diagram of Mr. Baldry's Set.*

which enables varying amounts of reactance to be used. This feature has been of considerable use at times.

The variable condenser (A.T.C.) is of the air dielectric type and consists of 21 plates, 11 fixed and 10 moving, cut from aluminium sheet approximately 1/64 in. thick. Great care was exercised in ensuring that the vanes should be absolutely flat and true, this being effected by careful pressing while under gentle heat.

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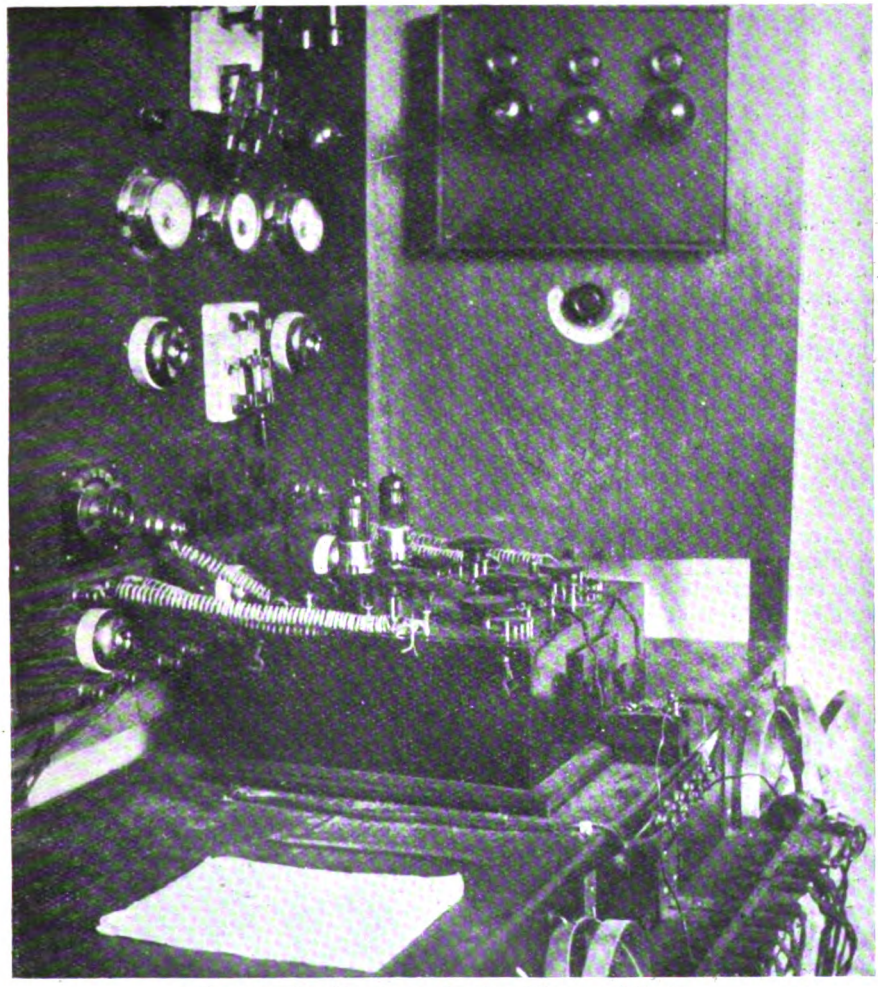
All internal connections are made with No. 20 S.W.G. rubber-covered, which was found to be sufficiently stiff for the purpose.

The switchboard was gradually assembled as the occasion arose, and the various switches and instruments were mounted on a polished teak board measuring 2 ft. 6 ins. by 2 ft. 6 ins. by $\frac{5}{8}$ in. All terminals were fitted in $\frac{3}{4}$ in. fitted to enable an instant change over from phones to loud-speaker. The panel on the right carries a three-valve L.F. amplifier which is still incomplete.

The aerial used is a standard P.M.G. aerial of 140 ft. twin wire carried on two masts 50 ft. high, the whole being very carefully insulated.



*The complete Receiver, showing Plugs and Jacks.*

ebonite plugs, thereby reducing capacity effects to a minimum. At the top of the board will be seen a single pole change over switch which enables the aerial to be connected to earth when not in use. The instruments consist of two voltmeters for measuring H.T. and L.T. voltage and one amperemeter. The double pole change over switch in the centre is

Results are very good, all Continental stations coming in clear and strong, whilst Croydon and 2 MT telephony can be heard comfortably on the loud speaker. PCGG is clear, but not so strong. The set being situated near Marlow-on-Thames, considerable interference is caused at times by Leafield, which is but 23 miles distant.

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# An Experimenter's Station at Yeovil

By L. W. C. MARTIN.

ON the left of the photograph (Fig. 1), mounted in the box, is a short and long wave tuner. The short waves are received on a variometer type of inductance enclosed inside the box, with five tappings, and tuning from 200 to 1,600 metres; also mounted in the box are two variable condensers of 0·002 mfd. and 0·0005 mfd. respectively.

The long wave coils are of the plug-in type, with tappings mounted on the side of the box, basket coils being used for waves up to 5,000 metres and lattice wound coils for above that wavelength and up to 24,450. For portability all tuning coils will pack away in the box through the small door seen in the front.

A change over from short to long wave coils, also series to parallel of condensers, is effected by one plug (2 pin) as shown in the circuit diagram, Fig. 2, thus doing away with two double-pole double-throw switches, which would take up rather too much room. There is another 2-pin plug for reaction coils.

The amplifier is 1, 2, 3 or 4 valves, all cutting out of valves being done by plugs; also various circuits can be tried in a few moments by changing about the plugs.

The first valve can be either H.F. transformer, tuned anode, or resistance-coupled.

Two transformers (H.F.) can be seen in the photograph, one of which is in position. These I have made from 300 to 2,800 metres. Above this wavelength I use resistances of 50,000 ohms.

The second valve rectifies; both these valves are "V.24" and have been in constant use for eighteen months. The two "R" valves are note magnifiers, and are controlled by one rheostat.

In the diagram of connections I have purposely omitted plugs and switches to avoid complication, except in the diagram of the tuner.

The amplifier has a hinge at each end of the base, and a box-like cover fits over the whole and is secured by two screws.

The H.T. battery is shown on the extreme right. With the four valves in use, and a very good indoor aerial, WII (New Brunswick), 13,400 metres, is easily readable with the telephones on the table when there is no jamming by Carnarvon.

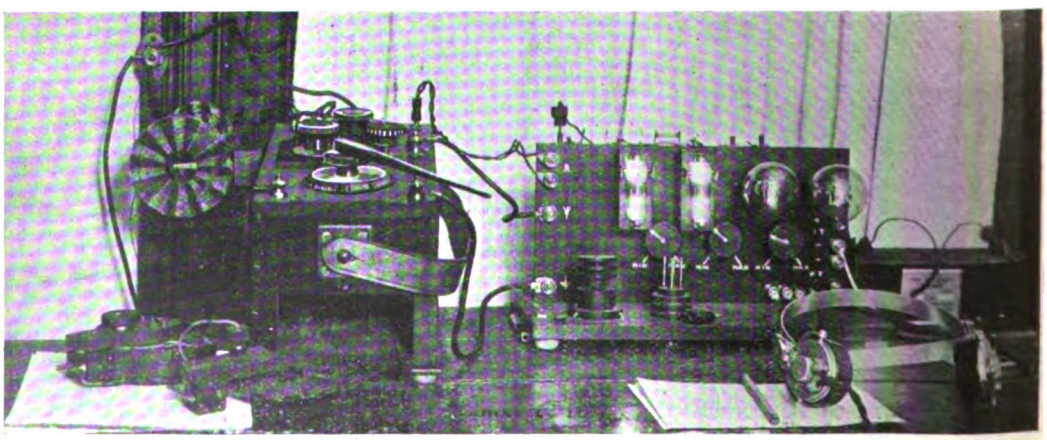

*Fig 1. The Tuner is on the left, and the Detector-Amplifier, using "V. 24" and "R" valves, on the right.*

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PCGG can be heard anywhere in the room with a gramophone horn attached on one earpiece of the telephones. Croydon need not be mentioned.

If I use my outside aerial and one more valve variometer coupled to the first valve of amplifier, PCGG can be heard anywhere in the house.

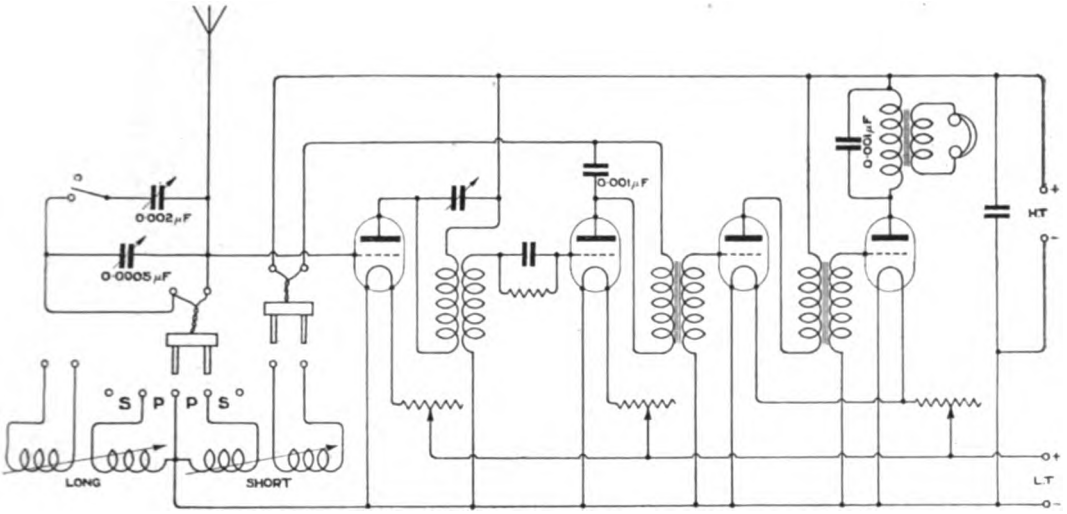


*Fig. 2. Circuit diagram showing Switching Arrangements for Short and Long Wave Tuning.*

# Croydon Aerodrome Wireless Station

## THE EQUIPMENT OF THE LONDON TERMINUS OF CIVIL AIR ROUTES.

THE wireless telephony station of the Croydon Aerodrome is perhaps the most familiar of all stations which the amateur in this country hears.

Visits have been made to the station by a good number of wireless societies in the London area, thanks to the courtesy of the Air Ministry, but the accompanying photographs of the station are published as being thought to be of general interest, especially to those who are familiar with the station on the wireless telephone but have not had the opportunity of visiting it.

At the Aerodrome there are two stations, one the direction-finding station and the other the radio-telephone station which is used for communication with aircraft.

The purpose of the direction-finding station is, of course, to take bearings on aircraft whilst in flight, and these are transmitted to the aircraft through the medium of the wireless telephone.

Fig. 1 shows the mast which carries the D.F. receiving station and the hut in which the instruments are located. The apparatus seen in Fig. 2 is the standard Marconi direction finder and receiver. On the right of the picture may be seen a wavemeter, and just in front of this the telegraph key.

Immediately in front of the main instrument can be seen a row of eight switches, which serve to control various circuits.

One serves to start up the main generators for the transmitter. Another serves to put into connection with the land-line telephone the table microphone seen in the picture,

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which is the microphone used for the transmissions by wireless telephone. In this way it is possible to relay ordinary land-line telephony through the local telephone exchange direct to aircraft in flight, and in this way passengers may be kept in communication with the ground whilst travelling.

Fig. 3 illustrates the transmitting apparatus, which consists of a Marconi 1½ kW. telephony transmitter.

The main aerial, that of the transmitting station, is supported between two lattice masts as shown in the illustration (Fig. 4).

The main generating unit consists of an A.C. motor which is run by the supply mains, and drives an A.C. generator. The generating plant is duplicated so as to avoid any risk of a breakdown in the service. D.C. generators for battery charging are also in duplicate for this reason.

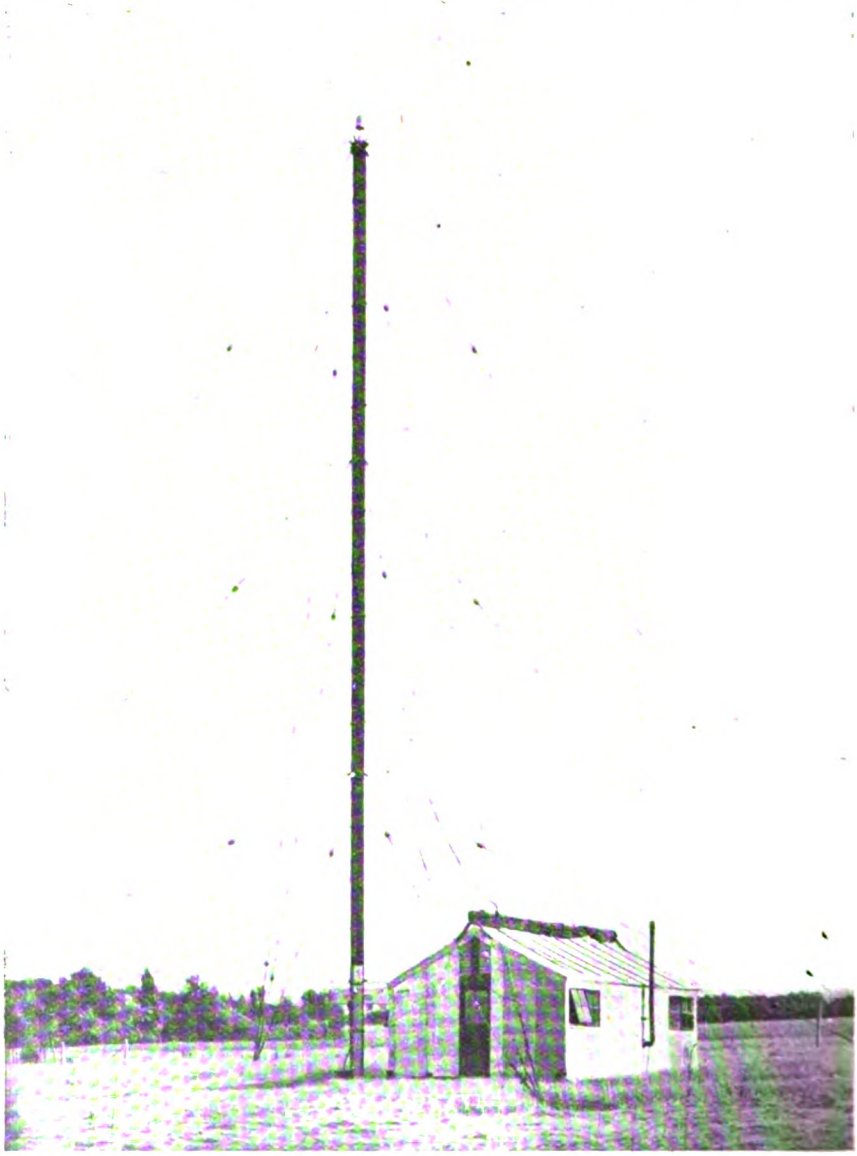

*Fig. 1. The Mast carrying the D.F Aerials.*

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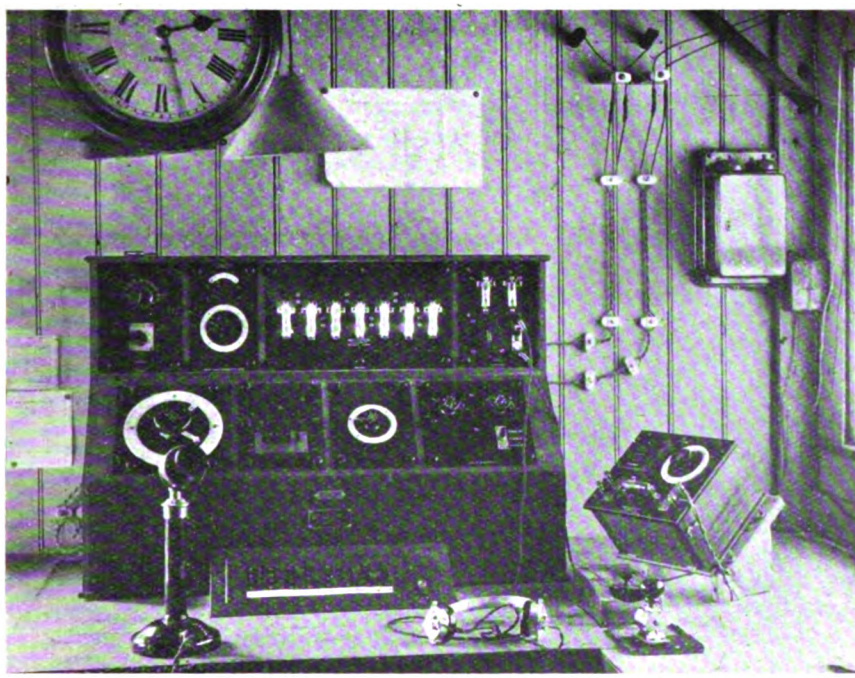

*Fig. 2. The Direction Finder and Receiver.*

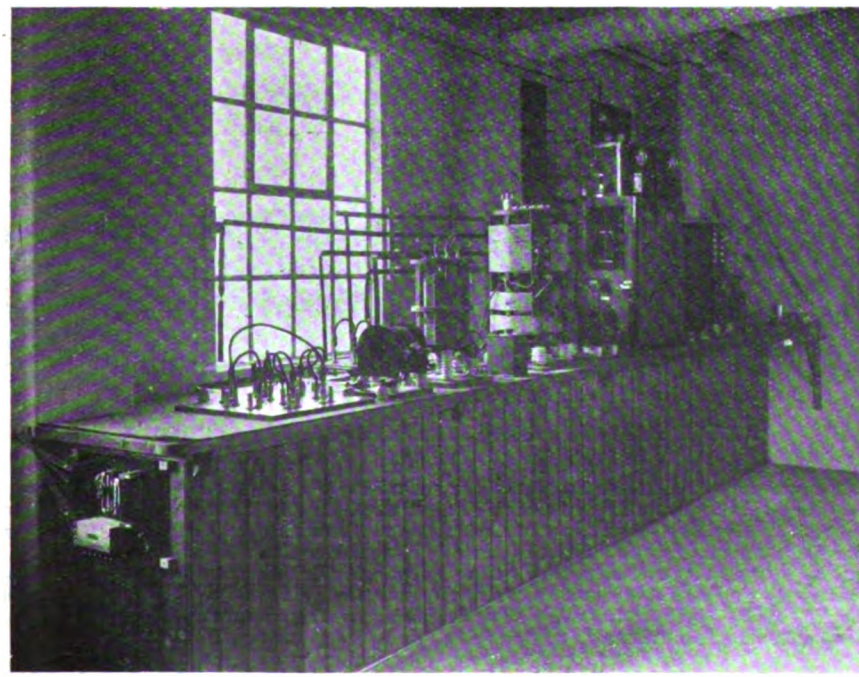

*Fig. 3. The Main Transmitting Apparatus.*

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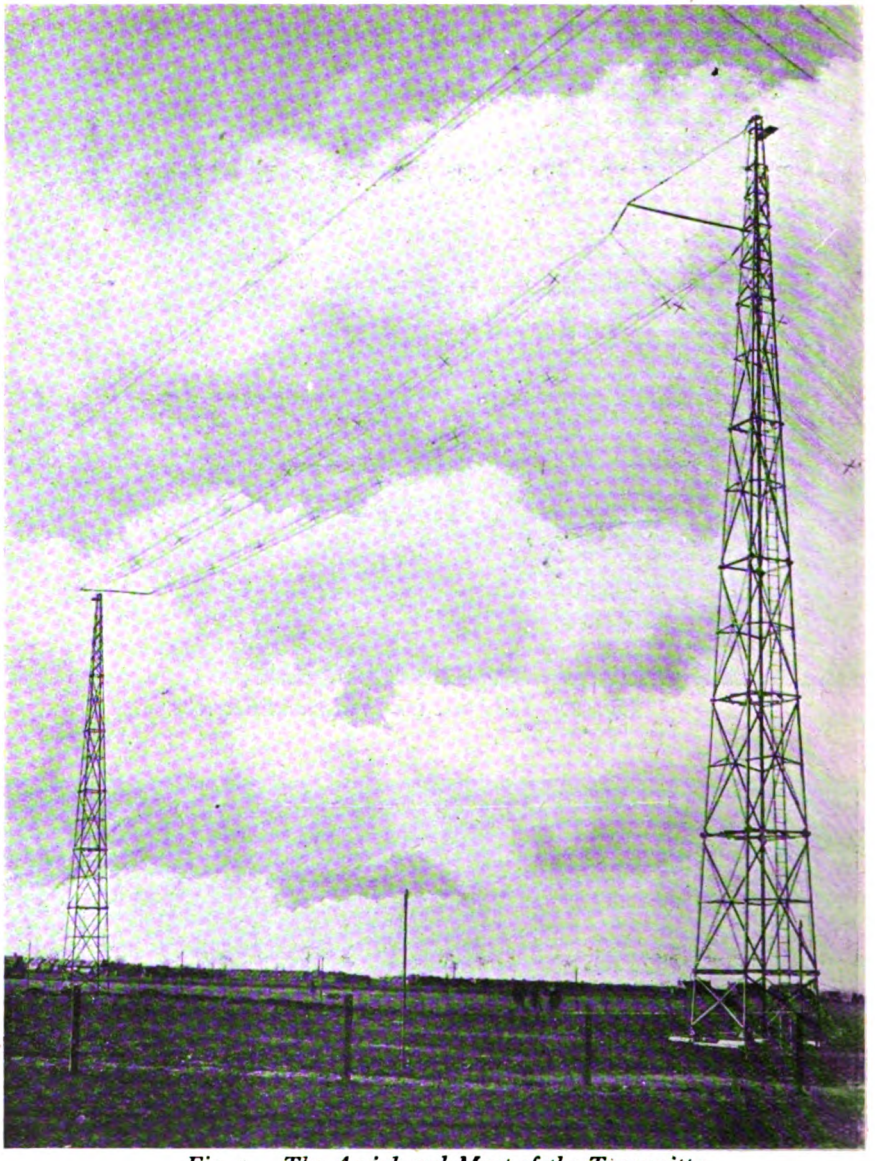

*Fig. 4. The Aerial and Mast of the Transmitter.*

## Progress of the Broadcasting Scheme.

At last a definite scheme for broadcasting has been agreed upon for the London area, and it is hoped that this will be put into operation on Monday, August 21st. It is hoped to commence in the provincial areas in six or seven weeks' time.

There will be a broadcasting centre for London. The apparatus is in readiness. All that remains to be done is to secure the Postmaster-General's approval of the company's memoranda and articles of association. The board of directors of the new company will proceed to deal with the provision of the provincial stations.

The Postmaster-General has laid down several conditions under which the broadcasting company will work. Profits are limited to 7½ per cent. per annum. For two years the apparatus will be limited to types submitted for the approval of the Post Office by members of the company, but to avoid anything in the shape of a monopoly the Postmaster-General has laid it down that any *bona fide* British manufacturer of wireless apparatus must be allowed to become a member of the broadcasting company, simply by taking a £1 qualifying share. The licence of the company will be subject to the maintenance of an efficient service. Towards the expenses of the broadcasting company, the Post Office will contribute a portion of the licensing fees paid for receiving sets, and a further contribution will be paid out of the purchase money on each set sold by the manufacturers.

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# Experimental Station Design

*Continued from p. 585, August 5th, 1922.*

*These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they may be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## X. LOW FREQUENCY INTERVALVE TRANSFORMER.

AS a step in the construction of a note magnifying unit a design is required for the intervalve transformer, and the following materials will be required.

Polished ebonite sheet 2⅛ ins. by 4¼ ins. by 7/16 in., 1 lb. No. 22 S.W.G. soft iron core wires in 9¼-in. to 10-in. lengths, a piece of black fibre 6 ins. by 12 ins. by 1/32 in. in thickness, two 6 B.A by ½ in. round-headed brass screws with nuts, 5 ounces No. 46 S.S.C., a small piece of scrap hard brass sheet about 18 S.W.G., odd pieces of silk ribbon and a few feet of insulated wire, 28 to 34 S.W.G., 12 ins of empire cloth 6 ins. wide.

The first step is the construction of the end pieces. Two circles, each 1 in. radius, are marked on the ebonite with dividers, and the ebonite sawn in two. The four corners of each piece are then cut away, going to within 1/16 in. of the line. If a lathe is available the next step will be to drill the holes in the centres and mount the two pieces on a spindle for turning down to size, and at the same time rounding the edges as shown in Fig. 1. Without a lathe, however, it is quite easy to file accurately down to the scratched circle. Having done this, set the dividers to ⅞ in. and make another circle on one side of each piece. Again resetting the dividers to ⅛ in, rest one leg just on to the

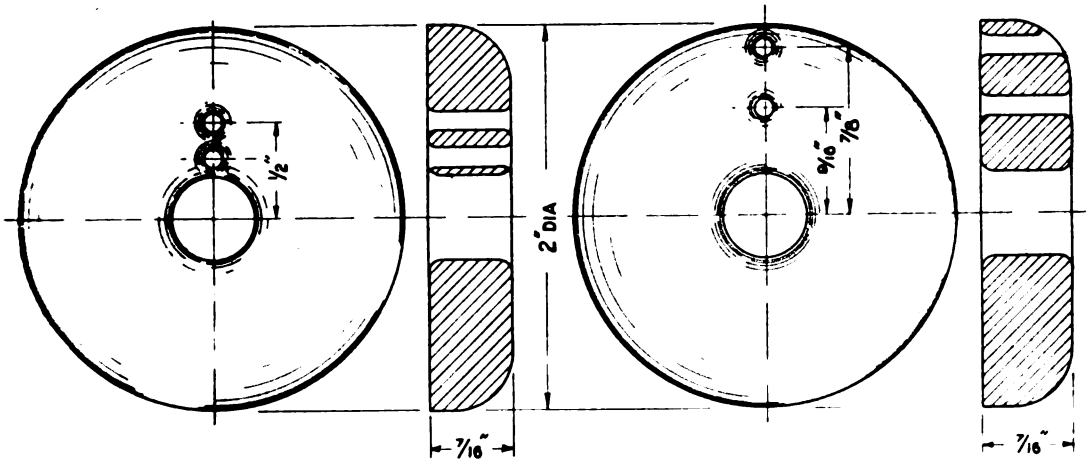


*Fig. 1. Ebonite end plates with rounded corners.*

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face on which this circle has been made and run a scratch line round the edge. This gives two scratch lines, one round the outside edge and another as a circle on the face. Carefully file away down to these lines, thus making a bevel. Having gone accurately to the line and so constructed a new face of equal width all the way round, remove the sharp edges as shown in the sectional drawing in Fig. 1. The hole can now be made through the centre, and if a hand brace is to be used, it is advisable to put a small hole through first, followed by the 7/16-in. drill. Two other holes are made in each piece for the leads at the positions shown. All of these holes are rounded, the small ones with the slightly moistened with oil to prevent rusting. With a little care it is easily possible to securely fix the end discs in position on the core.

This being done the core is wrapped twice round with empire cloth. It should be cut to about $2\frac{3}{16}$ ins. in width, and tiny cuts nearly $\frac{1}{8}$ in deep made at intervals of $\frac{1}{16}$ in. long. This will facilitate the edges spreading and building up against the ebonite, and so obviating the possibility of the primary winding pulling down in contact with the core. For the purpose of providing a short flexible lead three strands of instrument wire of about 30 S.W.G. are twisted together. One wire is left about 6 ins. longer than the other two, and at the point where the two terminate, the

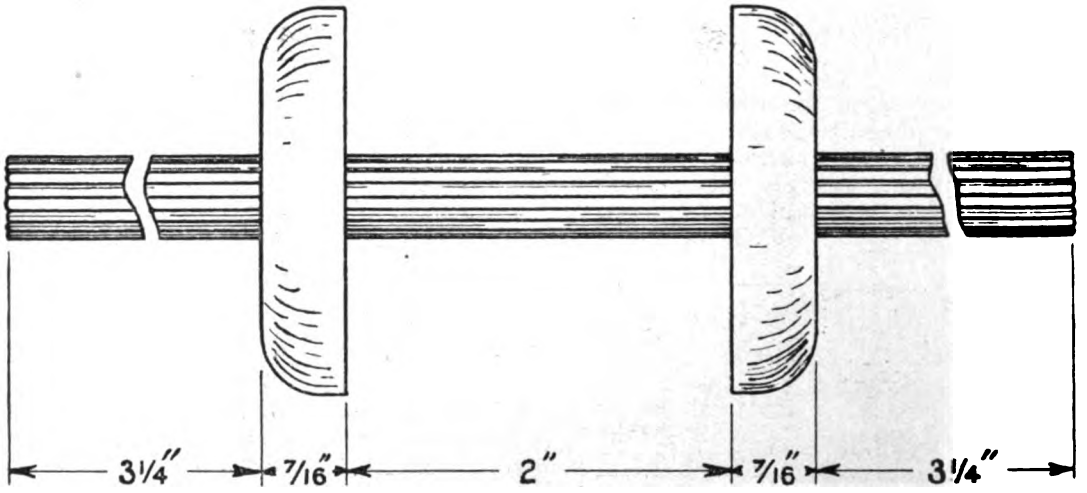


*Fig. 2. The core, consisting of soft iron wires, with ebonite end plates securely wedged in position.*

point of a large drill and the large ones either with the point of a drill or a rose bit. The small holes are slightly drilled out at both ends to prevent damage to the wires It is advisable also to run a fine file lightly and evenly round the sharp edges of the discs to prevent the very fine wire with which the transformer is wound from becoming damaged should it come in contact with the end pieces during winding.

The end pieces are now mounted on a bundle of core wires (Fig. 2), and it is most important that all wires shall be perfectly straight and parallel. Should there be any crossing over of wires in the core the ends may become slack when the wires are bent round. It is advisable that the wires be longer wire is scraped bare of insulation and twisted with the bared ends of the two shorter pieces. The joint should be soldered by using a little resin as flux, and with the tip of a well tinned iron. The end of the long wire is joined to the end of the wire with which the transformer is to be wound, taking very great care not to burn or overheat this fine wire.

Winding is somewhat difficult for the man not in possession of a lathe, but with a little patience the winding can be successfully accomplished with some improvised arrangement. As a suggestion the core wires may be mounted as a spindle in upright wooden bearings. To prevent friction on the wood causing the wires to grip and so displacing

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them, they should be wrapped very tightly with a piece of 22 gauge brass sheet at the bearing points A driving handle can be made from a strip of ebonite with hole and slot for gripping the core wires to the design shown on p. 584, August 5th issue. A 3/16 in. brass rod fixed through this with nuts will serve to revolve the arm and spindle. The reel from which the wire is being unwound must be carefully mounted so as to turn quite easily, or otherwise the wire will not be sufficiently strong to revolve it. If the winding is being done in the lathe the reel must be particularly free and should be plugged with a rod with pointed ends which run in holes in the ends of screws. When a stop is made during winding the reel should not be allowed to revolve on with impetus it may have gathered. Care is also necessary when starting, by not attempting to make the reel suddenly revolve rapidly. Start slowly, and gently speed up and steadily slow down before stopping. These difficulties do not apply when hand winding, but one must be careful not to turn with a jerky motion. When winding by hand a smooth brass rod through the centre of the reel will usually provide a bearing without too much friction.

Fine wires such as are used for winding low frequency transformers should not be purchased in reels carrying more than 4 to 5 ounces, or great difficulty will be experienced in unwinding owing to the momentum which a heavy reel will gather as it spins.

The primary is wound on up to a diameter of 13/16 in. This can be measured by means of callipers, but care must be taken not to damage the wire by sharp edges. Kinks must be avoided, and should breaks or kinks occur a joint must be made by cautiously twisting the ends together and lightly soldering, wrapping the joint with a piece of thin silk before continuing. The wire must be wound on evenly by slowly running from end to end in order to avoid any comparatively big difference of potential between consecutive turns. On completing the primary it should be tested for continuity with a milliameter or delicate galvanometer and a four-volt battery.

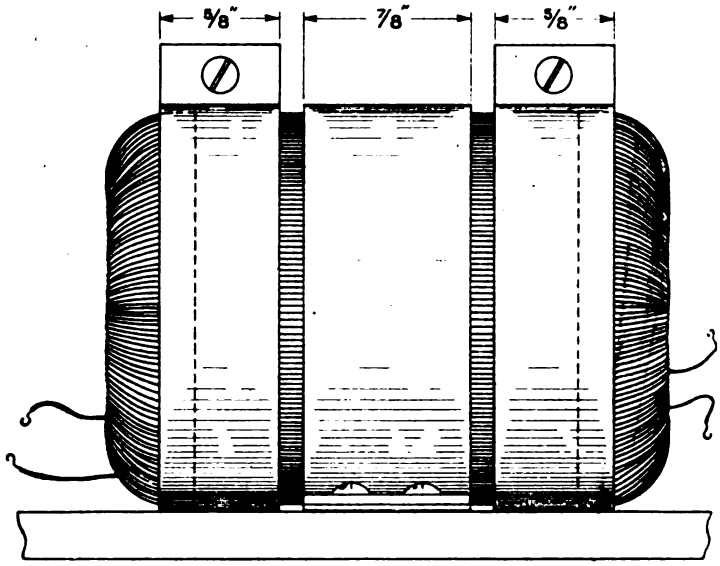


*Fig. 3. Side view of finished transformer. The dotted lines indicate the position of the ebonite ends.*

Three layers of empire cloth with frilled edges are wrapped over the primary winding to thoroughly insulate the two windings from one another and form a good bed for the secondary. One end of the empire cloth is held in place with the leading out wire of

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the secondary, whilst the other end must be tightly tied off with another piece of wire to prevent the empire cloth springing open before sufficient turns are put on to hold it down. This latter piece of wire must of course be removed, and on no account buried in with the winding. The secondary is wound on up to a diameter of 1¾ ins., and more care is needed than when winding the primary owing to the increased diameter and consequently higher speed at which the wire runs from the reel to bobbin. On completing to the required diameter the winding is wrapped with empire cloth of exact width to fit between the cheeks without turning up at the edges. A single layer of thread put on over the empire cloth will hold it down and entirely protect the wire.

Next a strip of fibre is cut to the exact width between the ebonite end pieces and yet not so tightly fitting as to force them apart, for it must not be overlooked that there is a great danger of breaking the winding if the cheeks bend outwards at all or move on the cores. The fibre is wrapped round and tied off at each end with thread. This piece of fibre is for keeping the end pieces perfectly spaced and for preventing them crushing in as the core wires are bent round.

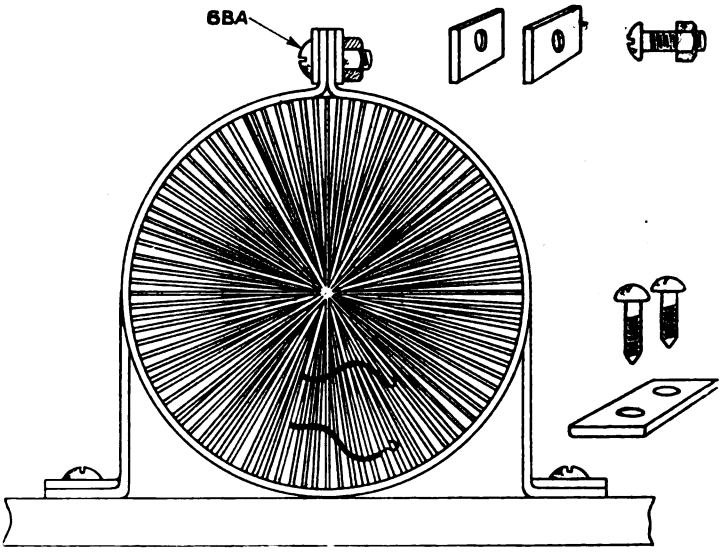


*Fig. 4. End view of Transformer when mounted.*

The core wires must now be spread out from a point at the exact centre at either end and bent down evenly all round and interlaced. Figs. 3 and 4 are sufficiently indicative of what has to be done and it is quite worth while making an effort to get all wires evenly distributed and free from bends other than at the centre and edges of the end pieces. Bends once made in the soft iron wires are hard to remove.

The wires should reach just beyond the ebonite pieces, on which their ends should rest, and are held in position by means of two fibre bands which should be placed over the wires so that they clamp them down on to the ebonite discs and completely hide the free ends. To give strength to the joint in the fibre bands small brass plates are made which are clamped together with the 6 B.A. screws and nuts.

The transformer is held to its base with another band of fibre, and it is advisable to mount the transformer permanently on a wooden base, holes in the corners of which serve for fixing to bench or panel.

This transformer has a turns ratio of approximately 1:2, and a resistance ratio of 1:4 Although in transformer design higher ratios are sometimes used, frequently no better results are obtained owing to insufficient primary turns. A 1:1 transformer with an efficient primary winding will give far superior results to a 1:4 transformer which has not sufficient primary turns.

The direction in which the windings are connected up in the amplifying circuit is important, first in order to get the right direction of potential fluctuation to the grid of the valve connected to the secondary, and secondly to obtain the correct capacity coupling between the two valves and making use of the capacity between primary and secondary windings. Both windings are put on in the same direction. The beginning end of the primary is marked "I.P.," and the finishing end "O.P.," the beginning end of the secondary "I.S." and its finishing end "O.S." "I.P." is taken to H.T. +, "O.P." to plate, "I.S." to grid and "O.S." to L.T.—.

F. H. H.

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# Notes

**Imperial Chain Station at Bourne.**

Proposals have been made to erect near Spalding, Lincolnshire, a transmitting station to operate as a link in the Imperial Chain. Its receiving station will be at Banbury.

Eight steel masts, each 800 feet high, will support the antennæ at Bourne. The masts are designed to take a horizontal pull of ten tons at the top and a wind load of 60 lbs. per square foot. They will form a square with the station in the centre.

Thermionic valve sets are to be installed, capable of transmitting continuously 90 words a minute in direct communication with Poona, Johannesburg and Perth (Australia).

At Banbury the new station is to be built on similar lines to the one now in existence which receives for Leafield.

If the above proposals are carried through, Bourne will be the largest station in this country.

**Special Arrangements for Aviators.**

An Air Ministry notification to airmen states that when meteorological and wireless facilities, in addition to or different from those normally available, are likely to be required, either: (*a*) For a special individual flight; or (*b*) for regular services on new routes; or (*c*) through changes in the routine services of aviation companies operating on recognised air routes, particulars should be forwarded (marked URGENT) to the Director of Civil Aviation (Room 550), Air Ministry, Adastral House, Kingsway, W.C.2.

In case (*a*) one week s notice should be given, with full particulars of the route, the proposed date and time of flight, and of the W/T or R/T equipment of the aeroplane.

In case (*b*) the period required for making any necessary arrangements before the commencement of the contemplated service will vary according to circumstances, but the necessary details should be supplied as early as possible.

In case (*c*) at least 48 hours' notice (Sundays excluded) of proposed changes should be given.

**Dutch Concert.**

Authority has been given by the Dutch P.M.G. for Concerts to be broadcasted from **PCGG**, The Hague, on 1,300 metres when the new aerial is erected toward the end of this month.

Until August 20th, by reason of the *Daily Mail* assistance, transmission will take place from 8.40 to 9.40 B.S.T. nightly, in addition to the present programme, and the power has been increased to 1 k.W.

**Suggested Association for Ireland.**

We have received a letter from Mr. H. L. Fletcher, Mona, Shankill, Co. Dublin, who states that having obtained permission from the authorities he is desirous of forming a Wireless Association for Ireland. He would be glad to receive communications from likely members, and secretaries of existing clubs.

**Sainte Assise Opened.**

Near the Forest of Fontainebleau, less than 30 miles from Paris, the largest station was opened at St. Assise, Melun, on August 7th. Although only one transmitting plant out of four is at present in operation, the other three are expected to commence work in a few weeks.

There are 17 masts, each 800 feet high, and when the station is in full working condition it is hoped to transmit 500 to 600 words a minute by sending five or six messages simultaneously.

*Miss E. Scarborough, of Messrs. Scarborough, Mitchell & Co., who won a prize for the very latest in carnival costumes. She went to a ball as "The Wireless World."*



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### An Amateur Station at Guildford.

The telephony from **2 HX** is familiar to amateurs in the Guildford district. The power used for transmission is only 4 watts and so the range is not very wide. Power for the valve is taken from a 600-volt generator, hand-driven, located under the bench, and the system of modulation is by grid control. Receiving side consists of detector valve, followed by two L.F. amplifiers. Tuning is accomplished by means of a set of lattice coils described by Mr. Philip Coursey, in the *Wireless World*, in December, 1920.

By kind permission of the Postmaster-General, much experimental work has been carried out on the low power, also a good deal of local demonstration work. Signals have been reported as good from stations as far as 35 miles away.

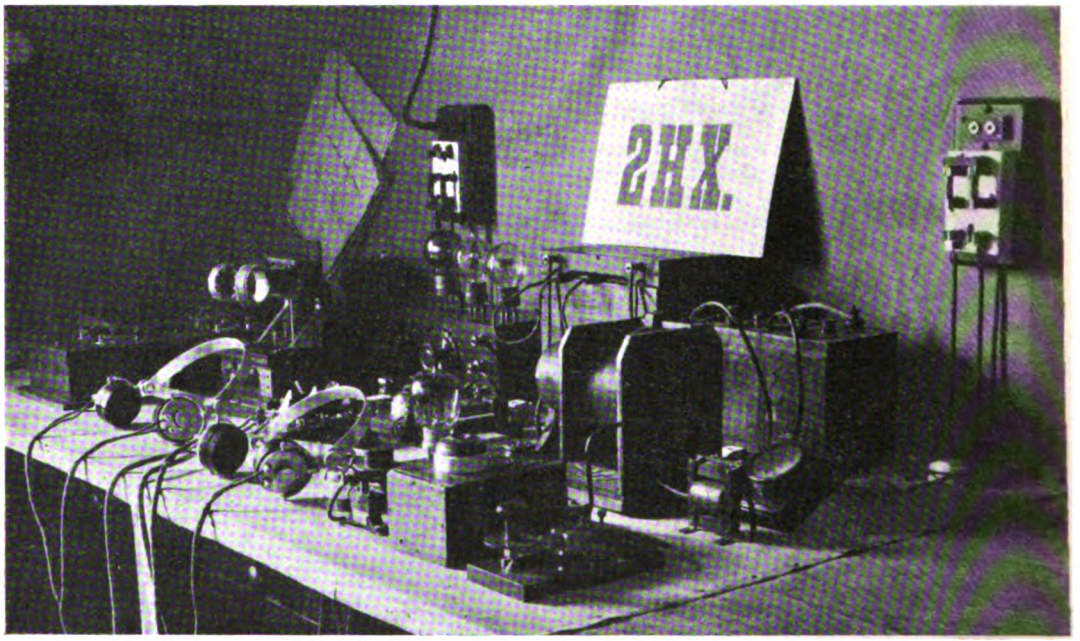
Most of the apparatus is home-made by Mr. F. A. Love, and seems to be fairly efficient, besides having provided many happy hours in the construction.

## APOLOGY

## "IMPORTANT PUBLIC WARNING"

We regret that in the advertisement columns of our issue of the 12th August we inadvertently published a statement under the above heading which we now realise was a very injurious one to the forthcoming Exhibition of the Radio and Wireless Exhibition and Convention which is to be opened at the Central Hall, Westminster, on September 2nd.

We desire to express our regret at the inaccuracy of such advertisement and for any injury or damage occasioned.




**2 HX**, *an Amateur Station at Guildford.*

### Ramsgate's First Concert.

The first wireless concert at Ramsgate was held a few days ago at a fête in Ellington Park.

Mr. F. Harrison, of Rochester Cottage, High Street, St. Lawrence, who is an enthusiastic amateur, is making an effort to form a local society.

### A Tuner for All Wavelengths.

In our issue dated July 29th, on page 543, a paragraph commencing "The A.T.I. Section," at the bottom of the right-hand column should precede the paragraph above it commencing "For the purpose of tuning."

### Australian Wireless Service.

It is stated in the *Commonwealth of Australia Gazette* that the control of wireless service in the Commonwealth has been transferred from the Postmaster-General to the Prime Minister "with such of the existing staff as the Prime Minister may require for the economic and efficient working of the service." The Wireless Telegraph Act, 1905-1919, is now administered by the Prime Minister as from June 1st, 1922.

### Sale of Apparatus.

A Committee of the Council of the Electrical Contractors' Association is investigating the subject, from the contractor's point of view, of whose business it is to sell and equip receiving stations. So far the Association thinks that if complaints and disappointments are to be avoided the business should remain in technical hands.

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# Correspondence

### Freak Reception.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I note in the July 29th issue of your paper a letter from Mr. Stevenson with reference to harmonics from **EAB**. I have had the same effect from **EAA** (Aranjuez) calling **POZ**. The wavelength would be somewhere about 350-400 m. I could not be certain, as I took no notice of it at the time. In this case I did not tune to the fundamental wavelength at all, but the signals were quite clear and readable, using 1 rectifier and a L.F. note magnifier.

Curiously enough, these effects were received at about the same time as with Mr. Stephenson—about 2200 B.S.T. I do not know if the effect is due to this particular period at night. I too have noticed that the French coastal stations come in very strongly about this time—recognisable by the call beginning with "F," and have often had **GRL** jammed out by them.

Is there any explanation for this "freak" reception ?

COURTNEY DRUMMOMD.

### 2 PF Heard on Indoor Aerial.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—It may interest **2 PF** to know that I received his music and read his speech here in Leicester, using three valves, and an indoor aerial; horizontal part nine feet long and lead to instruments five feet long.

He was working to **2 FN** on Sunday, July 30th, at 1845 hrs. G.M.T. **2 FN** comes through much louder, of course, by reason of his position.

The aerial is about eighteen feet from ground level, in the centre of the town, and close to the electric traction routes.

T. S. SKEET.

Leicester.

### The Reinartz Transmitter.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am pleased to note the interest of *The Wireless World and Radio Review* in the circuit arrangements of Mr. John L. Reinartz which has been presented through *QST*. As the author of this article in June *QST*, which is reproduced on pages 447 and 448 of your issue of July 8th, however, may I point out an error in your Fig. 1? The choke coils as shown in *QST* were radio chokes, but in your diagram you have shown them with iron cores, which is incorrect. The one in the anode supply is to prevent the radio frequency oscillations from by-passing through the source of power and as nearly as possible should be resonant to the oscillating frequency. The choke in the grid lead is the customary very small inductance which American amateurs use in power tubes for the purpose of choking out parasitic oscillations at an ultra-radio frequency. Such a choke may well consist of about 20 turns of wire on a ½-inch form. Their use is desirable only when a multiplicity of tubes is used in parallel.

K. B. WARNER.

The American Radio Relay League.

# Calendar of Current Events

**Sunday, August 20th**

Transmission of *Daily Mail* Concert from 2.30 to 5 p.m. and from 8 to 9 p.m. on 1,085 metres by **PCGG** The Hague, Holland.

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY. Field Day.

**Tuesday, August 22nd**

Transmission of Telephony at 8 p.m. on 400 metres, by **2 MT** Writtle, near Chelmsford.

**Thursday, August 24th**

Transmission of *Daily Mail* Concert at 8 to 9 p.m., on 1,085 metres, by **PCGG** The Hague, Holland.

ILFORD AND DISTRICT RADIO SOCIETY. At St. Mary's Hall, High Road, Ilford. Lecture on "Short Wave Reception, with Special reference to Damped Waves," by Mr. E. E. Hale.

**Tuesday, August 29th**

Transmission of Telephony at 8 p.m. on 400 metres by **2 MT** Writtle, near Chelmsford.

**Wednesday, August 30th**

SOUTH SHIELDS Y.M.C.A. WIRELESS SOCIETY. 7.30 *p.m.*—Fowler Street. General Meeting.

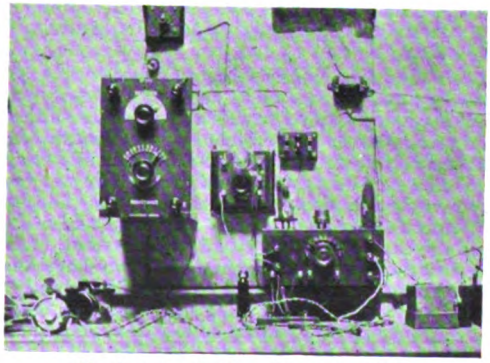
**Thursday, August 31st**

RADIO EXPERIMENTAL ASSOCIATION, NOTTINGHAM AND DISTRICT. Meeting.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION. At Belmont Road Schools, Chiswick, W. First meeting after vacation.

CROYDON WIRELESS AND PHYSICAL SOCIETY. Meeting.

### Eastbourne College Wireless Club.



*Eastbourne College Receiving Set.*

The Club whose apparatus is shown above, holds its meetings on Tuesday evenings. It has fifteen members. Next term the Club hopes to obtain a transmitting licence.



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# Wireless Club Reports

***NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.*** **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## Derby Wireless Club.*

Hon. Secretary's address, "The Limes," Chellaston, Derby.

In a series of eight lectures, extending over the last twelve months, Mr. E. Fowler Clark, B.Sc., B.A., A.M.I.E.E., has described the results as progressively obtained, of a very thorough mathematical and experimental investigation of the behaviour of an ordinary hard three-electrode thermionic valve as applied to radio reception.

As a preliminary, the first lecture consisted of a description of up-to-date ideas of charges, direct and alternating currents, unilateral conductivity, potential, electric and magnetic strains, energy transformations, ether waves, and electronic emissions from hot bodies, in terms of the electronic nature of electricity and of the atomic constitution of matter.

The second lecture dealt with inductance and capacity, the various arrangements of tuned aerial receiving circuits, types of transmitted waves and received oscillations and impulses and the utilisation of the maximum induced alternating potential to actuate detecting devices, also with the advantages of the closed secondary oscillatory circuit.

Mr. Clark then proceeded to describe, with the aid of a series of very carefully taken experimental curves, the various characteristics of the two and three-electrode hard valves and the methods by which, utilising suitable features of these characteristics, the rectification effect necessary to convert intermittent radio oscillation trains into audio-frequency telephonic impulses could be obtained, coupled in the second instance with amplification. Bend and grid leak condenser rectification were considered in detail and particularly the effects of experimentally varying the applied anode and grid potentials.

Following this, and as a preliminary to the consideration of the valve receiving circuit with loaded anode circuit to which it is analogous, an alternating current circuit consisting of inductance and capacity in parallel, supplied from an alternator through a resistance, was considered. The changes occurring in the magnitudes and phases of the total and branch currents as first the inductance and then the capacity in the circuit is increased, under the action of the alternator P.D. or that impressed on the grid, as the case may be, were illustrated by means of a vector circle diagram, attention being drawn to the cases of tuning and over-tuning of the varied (anode) circuit.

Reception of spark transmissions on a tuned anode circuit with crystal rectification and no reaction, on the above principle, was then referred to, after which Mr. Clark diverted to describe, with the aid of distributed diagrams, his circuit arrangements, by which nearly the whole of the experimental portion of his investigations could be carried out by switching only.

The principles of electro-magnetic and electrostatic reaction, by which the anode circuit current and voltage respectively are utilised via suitable inductive or capacity coupling to inject into the grid oscillatory circuit assisting components of voltage and current, were then indicated, and, on a straight line valve characteristic and zero grid current basis, the phenomena associated with changes of the variable quantities, including those relating to the limits of oscillation, which had been arrived at mathematically and confirmed experimentally, were pointed out.

Finally, Mr. Clark described, with the necessary explanations, the results of experimental work on the production of the oscillation with various values of grid and anode potential, also of grid leak potential in the case of the grid leak, indicating the conditions in which the phenomenon known as "overlap" would occur.

Mr. Clark consented to give further lectures, describing from time to time his further experiments as they progress.

## Hounslow and District Wireless Society.*

Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow.

On Saturday, July 22nd, a demonstration was given at the Isleworth Hospital Fête, all members assisting in erecting the apparatus and aerial. Special permission was obtained from the P.M.G. enabling Lieut. Walker (2 OM) of Brentford, to transmit music. This he did in his usual style. Everything went off well and a good sum was handed to the Hospital Fund.

On Thursday, July 27th, a public demonstration was arranged at the Council House. This being the first night of the *Daily Mail* broadcasting from Holland, nearly 700 people were present and reception was very good indeed, except for the usual interference. Afterwards, Lieut. Walker gave a very stirring address to the audience, pointing out the Society's work in the district, and stating further that after the success that evening in receiving the Hague concert, support was desired more than ever. He also promised to transmit when he got home. This he did at 9 p.m. His music was extremely loud and was heard in the street on the Society's Brown H.1 loud speaker. Councillor W. J. Heath, J.P., chairman for the evening, received a message transmitted for his special benefit by Lieut. Walker, and enjoyed the experience as much as the audience. At 9.30 p.m. the Society's first public demonstration closed down.

On Saturday, July 29th, another demonstration was given at the Hounslow Hospital Fête. Lieut. Walker again obliged, and at 9.10 p.m. Marconi House (2 LO) was picked up, where a local singer

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was performing. This demonstration went off without any trouble and a further good sum was handed to the Hospital.

The members are well pleased with a brisk week's work. If any gentleman would care to join the Society, he should write to the Secretary.

### Stoke-on Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of the Stoke-on-Trent Wireless and Experimental Society, held on Thursday, August 3rd, it was decided to admit the members of the Y.M.C.A., in whose building the Society have made their headquarters, at a reduced annual subscription.

A Committee meeting has been called, to hurry forward as rapidly as possible the erection of the aerial and the fitting up of the new club-room to suit the Society's needs. It is hoped to have everything ready by the end of the month, and to have a formal and probably public opening.

### The Gloucester Wireless and Scientific Society*

Hon. Secretary, Mr. G. T. Peck, 45, Denmark Road, Gloucester.

At a meeting held at headquarters on July 3rd, Mr. B. T. Gowing demonstrated with a two-valve set of original design. The resistance-capacity circuit used—the outcome of much experimental work—worked well over all wavelengths, even as low as 300 metres, and Mr. Gowing seems to have overcome the usual drawback of the resistance-capacity circuit, *i.e.*, inability to work below 1,000 metres. During the course of the evening some very good signals were obtained on the club's aerial.

At a meeting of the Society on July 31st, Mr. C. Minchin gave a second lecture on "Dynamos." This proved to be very interesting, the lecturer producing several formers and coil-winding machines used in the manufacture of dynamos.

Although during the summer months the Society's activities have been somewhat curtailed, it is hoped that anyone interested in amateur wireless will communicate with the Hon. Secretary, who will be pleased to answer all enquiries at the above address.

### Ilford and District Radio Society.*

Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, E.7.

At the request of several of the members, Mr. E. E. Hale had prepared a lecture on "Don'ts." This he delivered on Thursday, July 13th, with his customary vigour and in a systematic manner, commencing with the aerial and working through the set to the telephones, emphasising the things that an amateur should not do under any circumstances, and criticising the experiments that, while permissible, are from a beginner's point of view best left alone. The discourse proved most informative without being redundant in any way, and was greatly appreciated.

Mr. A. J. Thompson lectured on Thursday, July 27th, and demonstrated "Aerials, Earths and Wiring." The lecturer condensed his information exceedingly well, and his explanations of the different types of aerials in use with their respective merits and demerits were of high value.

By the courtesy of the Electrical Engineer to the L.C.C. Tramways, who had kindly provided the Society with the necessary permit, a party of members were enabled to pay a visit to the Council's generating station at Greenwich on Saturday, July 29th. A guide took the party round, and the visit proved an afternoon's thorough enjoyment. The active membership of the Society is steadily increasing, and now stands at 52, nearly all of whom have receiving permits, while there are eleven transmitting licences including the two possessed by the Society itself.

The Society's latest step on the road of progress is the completion of affiliation to the Wireless Society of London.

### Wireless and Experimental Association.*

Secretary, Mr. Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

The meeting on Wednesday, July 26th, was very well attended, and general queries were very fully dealt with for the edification of the newer members. The Chairman started a very interesting discussion on multiple aerials, and aerials used multiply. That involved finding out what would happen were several aerials in close proximity used at the same time on the same wavelength, and how interference could be prevented by having their ends connected together, thus forming parallel oscillatory circuits which, if oscillating, would do so at a common frequency. Mr. Voigt followed up by describing what would happen in almost every possible arrangement of three stations working near each other on the same, separate and connected aerials. Most of the points, although not practicable for the amateur, were of exceptional interest.

On Wednesday, August 2nd, the application and advantages of two-slide inductances over single slide inductances was explained. The Chairman then described practically every practicable form of detector, giving useful information for the handling and use of the multitudinous combinations of crystals and pointing out as far as possible how each may be identified. A competition was announced for the best wireless gadget. No limits were placed, except that it had better be some little valuable article.

Communications and enquiries to the Assistant Secretary (Mr. W. J. Joughin), 21, Troughton Road, Charlton, S.E.7.

### Lion Radio Club, Shoreditch.

Hon. Secretary (pro tem.), Mr. A. V. Turner, 35, Aske Street, Pitfield Street, N.1.

The above club is in the course of formation and the Secretary would be glad to hear from amateurs in the district who are likely to become members. He would also welcome catalogues and literature which might be of interest to the members. Intending members should write or call at the above address.

### Otley and District Wireless Society.

Hon. Secretary, Mr. Y. C. Weston, 24, Guycroft, Otley, Yorks.

On August 3rd, at 7.30 p.m., the second meeting was held at the Café, Queen's Hall, Otley.

After the minutes of the last meeting had been read and passed, two lectures were given. Mr. N. Weston lectured on "Electrostatics," and Mr. Dey lectured on the subject of "Signalling."

Several new members were enrolled. A further meeting was held on August 17th.

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### The North Essex Wireless Society.

Hon. Secretary, Mr. F. T. Smith, Headquarters, 15, Rayne Road, Braintree.

A field day was arranged for August Bank Holiday for members, at Mr. Lagden's station, Gt. Leighs. The object of the experiments was to prove to those possessing reaction circuits exactly what an amount of local interference their misuse caused.

Using the above gentleman's station as a base, a temporary station was erected about 300 yards away. The result was that those present were able to learn how to reduce their re-radiation to a minimum. As a forcible proof to those who might have been careless about tight-coupling, a microphone was placed in the anode circuit of one receiver and both music and speech were received clearly and loud in the other receiver. Single valve sets were used in both cases, and it is thought that by mutual agreement, arrived at through these experiments, there will be much less local interference in the district. At the conclusion Mr. Lagden kindly entertained the members of the Society to tea and was accorded a hearty vote of thanks for his kindness. Before leaving, music was transmitted by **2 ZV**, and this concluded a highly successful and satisfactory day.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society was held on July 26th at the Assembly Rooms and a pleasant evening was spent.

The members of the Society did exceedingly well with their amateur constructed sets in receiving the broadcasted concerts from the Hague on July 27th. The best attempt to hand is that of Mr. Lush, of Fitzhugh, Southampton. Using a four-valve L.F. constructed set he was able to hear the whole of the concert all over the large room without the aid of a loud speaker. Mr. Lush states the music was louder than **FL**, which goes to show the excellent results obtained. Congratulations from all the members of the Society are offered to Mr. Lush.

A further meeting, held on Wednesday, August 2nd inst., resulted in one of the largest attended meetings of its members yet recorded. As members are steadily increasing, great things are being looked forward to during the winter. It has not yet been definitely decided to engage the present club-room for a further period of six months as it is hoped to obtain another room. Therefore, the improvement of the club aerial is at present at a standstill.

The following were elected as members on July 27th and August 2nd :—Col. Neade, Messrs. Bovey, Southard, Smith, Hirst, Dickenson.

All amateurs in Southampton and district can be supplied with particulars of the Society on application to the Secretary.

### The Hornsey and District Wireless and Model Engineering Society.

Hon. Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

On Tuesday, August 1st, 1922, a successful meeting was held at 29, Felix Avenue, Weston Park, Crouch End.

A two-valve resistance-capacity set was tried out and the reception of C.W. and spark signals was loud and clear.

Also a one-valve set was demonstrated and music and telephony from several amateur stations were listened to with interest, including **2 MT**, who are to be congratulated on their splendid transmission.

Several new members were enrolled and others are heartily welcome. All particulars from the Hon. Secretary.

### Clapham Park Wireless Society (Embracing Streatham Hill, Balham, and Tooting Districts).

Hon. Secretary, Mr. J. C. Elvy, 3, Fontenoy Road, Bedford Hill, S.W.12.

A very successful inaugural meeting was held under the chairmanship of Mr. J. C. Elvy, A.M.I.E.E., etc., Consulting Electrical Engineer, at the Studios, 67, Balham High Road, which were graciously lent for that purpose by Mr. M. P. Prout, Cantab., at 8 p.m. on August 1st, 1922.

After a brief conversazione, the fifteen present, namely, Messrs. J. Gray, C. A. Griffiths, W. W. Millar, M. P. Prout, J. C. Elvy, A. E. Redburn, W. Brierley, R. H. J. McCue, H. R. Knott, H. E. Austin, A. L. Beedle, R. McCue, F. H. Austin, V. L. Natusch, R. O. Rippon, sat down to business. Mr. J. C. Elvy was elected Hon. Secretary. Mr. M. P. Prout was elected Hon. Treasurer. Elected to serve on Committee :—Messrs. J. Gray, W. Brierley, A. L. Beedle, R. H. J. McCue.

In furtherance of an endeavour to secure a representative of each sub-district to facilitate future organisation, further nominees may be selected for Streatham Hill and Battersea portions of area concerned.

The next item dealt with was a suitable title for the club. The proposed word "Scientific" was omitted as it was agreed that the abbreviated title would not preclude dealings with other subjects should members so desire on occasion. The decision therefore is as above.

It was decided to hold meetings every Wednesday at 7.30 p.m. in winter, and alternate Wednesdays in summer at 7.30 p.m., i.e., fortnightly up to September 30th next, the next meeting being fixed for August 9th.

The question of subscriptions arose, Mr. M. P. Prout generously offering to extend the loan of the premises till further notice, and after discussing varying rates for juniors and seniors, it was provisionally decided that the subscription be 7s. 6d. annually, payable in advance, as from August 1st of each year, and within one month. Entrants in last six months of the year to pay 4s. subscription, to carry them up to following July 31st. All entrants after the first fifty enrolled to pay 2s. 6d. entrance fee in addition.

After a hearty vote of thanks had been accorded to Mr. M. P. Prout for material assistance rendered by allowing use of his studios as provisional headquarters ; also to Mr. J. Gray for offering to institute buzzer practice as an appetiser at 7.30 p.m. each meeting ; and to the Chairman for so ably conducting the Society through its initial stages, to which suitable references were made, the meeting was brought to a close at 9.30 p.m.

The question of aerial and other equipment for the Studios, has already been touched upon.

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### Aberdare and District Wireless Society.

Hon. Secretary (*pro tem.*), Mr. J. Owen Lewis, Ailtyblacca, Danyderi Street, Godreaman, Aberdare.

A meeting of wireless enthusiasts of the Aberdare Valley was held at the Cwmaman Public Hall on Thursday, July 27th, when it was unanimously decided to form a Society under the above name.

Mr. A. E. Hay (**2 KG**), of "Glendale," College Street, Aberdare, was elected to the chair, and under his able guidance, a very profitable evening was spent. A membership of nineteen was registered, but in view of the fact that about 18 to 20 prospective members were unable to attend, it was decided to hold an official inaugural meeting at a later date.

In the meantime Mr. Hay, Mr. J. Owen Lewis, Mr. Parry and Mr. Duffy were appointed to act as Chairman, Hon. Secretary, and a committee of two, *pro tem.*, until the first official meeting, which is to be held in Aberdare on Thursday evening, August 10th, at 7 o'clock.

The Society is extremely fortunate in having secured the active interest of Mr. Hay, who, as the founder of the South Wales Wireless Society, is well known as the pioneer of amateur wireless work in Wales, and who has achieved some records in amateur transmission.

The Society has been offered the use of an excellent lecture hall in the main thoroughfare of Aberdare, and it is anticipated that the meeting which will be held there on August 10th will be very successful, as at the beginning of August upwards of fifty applications for membership are to hand, and all local electrical workers are keenly interested in the new society.

A vote of thanks was tendered to Mr. Ray of the Cwmaman Public Hall for his kindness in having placed a room free of charge at the disposal of the meeting.

Candidates for membership can obtain all particulars from the Hon. Secretary.

### Walthamstow Amateur Radio Club.

Hon. Secretary, Mr. R. Cook, 49, Ulverstone Road, Walthamstow, E.17.

A most successful wireless demonstration was given on July 25th at the Club headquarters, Y.M.C.A., Church Hill, Walthamstow.

Over 400 were present and greatly enjoyed the short lectures given by Mr. Oswald Carpenter (Research Dept.), of the Marconi's Scientific Instrument Company, Ltd., and also the music which was received from various sources. Mr. Carpenter informed the audience that this was the first demonstration of the "Magnavox" loud speaker and the "Magnavox" power amplifier before an English wireless society.

Several times during the various items of music Mr. Carpenter had to shut down owing to the jamming from various inexperienced amateurs in the neighbourhood.

**2 MT**, who gave us a special call, came through very loudly and distinctly, and could be heard with ease all over the large hall.

Mr. Carpenter also brought with him some very interesting lantern slides, showing some of the earlier stations and also the modern ones, including one of Senatore Marconi endeavouring to fly a kite in Newfoundland when the first transatlantic wireless message was sent.

A hearty vote of thanks was passed by the meeting to Mr. Carpenter for his kindness in giving such an interesting demonstration.

Over thirty new members were enrolled, bringing the total up to 70, and the Club is now looking for a larger room.

Meeting every Wednesday night 7.30 to 10 p.m. at above address.

### Guildford and District Wireless Society.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

On Saturday, July 29th the members of the above Society gave some demonstrations in aid of Chiddingfold Hospital Saturday Fund. On the whole the day proved successful. Mr. F. A. Love, of Guildford (**2 HX**) very kindly gave three transmissions of music in the afternoon, and at 7 p.m. gave out cricket results, etc., from the evening newspaper. A call from Marconi House (**2 LO**), and the reception of their three concerts at 5, 6 and 9 p.m. also added to the success and popularity of the demonstrations. A four-valve set, the property of Mr. R. C. Patrick, a member of the Society, was used, and in spite of being transported ten miles, performed the duties expected of it most admirably. It is hoped the efforts proved beneficial to the Hospital Fund.

The Society is still anxious to swell its membership, and therefore the number of sets; a good piece of advice would be for everyone starting on the fields of wireless to become a member of the nearest Society, where they will find first-class advice given willingly. Any amateur in the neighbourhood is heartily invited to come to the Society's room at 46, High Street, Guildford, on any Monday evening at 7 p.m.

### The Fulham and Putney Radio Society.

Hon. Secretary, Mr. J. Wright Dewhurst, 52, North End Road, West Kensington, London, W.14.

The monthly meeting of the above Society was held at their temporary headquarters, 232, Putney Bridge Road, on Thursday, August 3rd. There was a fair attendance and several new members were enrolled. Amongst other business it was proposed that as soon as the question of suitable accommodation was settled, that the Society become affiliated to the Wireless Society of London. A very interesting discussion on wireless topics took place amongst the members and several gave their experiences with wireless during the late war.

At the next meeting it was arranged to have a three-valve set (lent by Mr. Houstoun) working to receive some amateur transmissions.

### Sutton and District Wireless Society, Surrey.

Hon. Secretary, Mr. E. A. Pywell, "Stanley Lodge," Rosebery Road, Cheam, Surrey.

The Secretary begs to announce that, owing to a considerable increase in the number of members, a larger room has been engaged for the meetings.

This necessitates a change of meeting night from Thursday to Wednesday, commencing on 9th August (8-10 p.m.).

This new room is in the same building, namely, the Adult School, Benhill Avenue, and, with the increased facilities, a special effort will be made to help the beginners.

Will all in the district interested in wireless, both beginners and experts, attach themselves to the Society and thus ensure its continued success.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—*(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, 12/13, *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents.* (6) *Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of* 1*s., or* 3*s.* 6*d. for a maximum of four questions.* (7) *Four questions is the maximum which may be sent in at one time.*

**"H.E.P." (North Greenwich).**—We gather from your remarks that you have added a L.F. to your crystal set. The further improvement you request could be obtained by adding a H.F. valve, one of various suitable circuits being as shown in Fig. 1. The circuit should then give the results required.

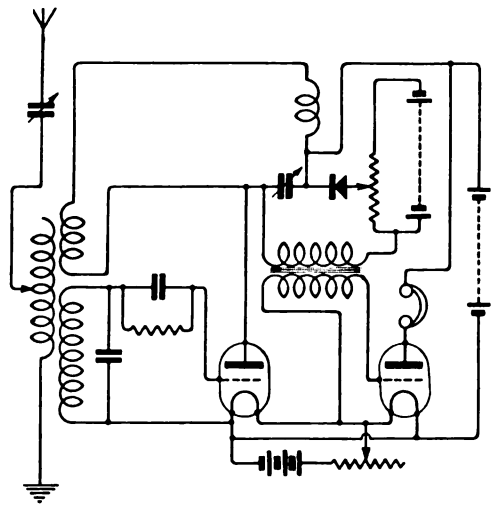

*Fig.* 1.

**"F.W.S." (Nottingham)** *wishes to know* (1) *How to convert a Mk. III long wave tuner to give reaction effects.* (2) *Whether in attaching his Mk. III tuner for use as a component of the Armstrong super-regenerative circuit, he should make connection between the oscillator valve, grid coil, and the A.T.I. by means of a variable coupled inductance, or by connection to the top of the coil.* (3) *Should the oscillator valve grid coil tune to the same wavelength as the A.T.I. of the tuner.*

(1) Isolate the closed circuit, which can be done by placing the change-over switch in the stand-by position. The telephone terminals should be short circuited, and leads taken from the opposite sides of the crystal detector, which should be put out of action to the grid and L.T. minus of the valve. The closed circuit should then be connected to the plate, and one of the telephone leads. A condenser having a value of about 0·002 mfds. should be connected across the telephones. A suitable condenser will be found inside the set already connected to the short circuited telephone terminals. The other telephone lead is then taken to H.T. plus, H.T. minus being taken to the filament battery. This tuner is usually provided with two contacts, which are closed when the change-over switch is placed in the tuned position. As you will be making use of the closed circuit whilst the switch is over on the other side, you will need to short circuit these two contacts. This tuner is quite good for giving reaction effects when so corrected. (2) The position of the tap should be variable, and it is better to use an additional coil wound in the same direction as the secondary inductance, one end of which is connected to the L.T. battery and the other taken across to the grid of the oscillator valve. The oscillator must be arranged to give wavelengths of the order of 30,000 metres—that is, just above audible frequency. (3) It is regretted that we are unable to advise you further in the manipulation of this circuit, as very little data concerning the dimensions of the coils is at present available.

**"P.H." (Coventry)** *is constructing a three valve receiver built up on the unit system, and wishes to know whether his panel wiring, as shown in his diagram, is correct.* (2) *The values for the grid leak, grid condenser, and telephone condenser.* (3) *Whether the set could be used in conjunction with the tuner described in the issue of July 15th, and* (4) *Whether we consider it advisable for him to abandon the unit system he has devised and adopt that described in recent issues.*

(1) Your circuit diagram is quite in order, but it is difficult to trace out precisely your practical wiring diagram. However, it appears to possess no special merits over the designs put forward in the articles to which you refer, and we strongly recommend you to follow these articles as a guide for the construction of a long range multivalve receiving station. The advice given is in every way reliable and complete, and should you experience any difficulty in making up the apparatus, we shall be pleased to assist you.

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**"SPARKS" (Bingley)** *describes his three-valve set and asks for a wiring diagram for same, so that one or both of the H.F. valves may be cut out.*

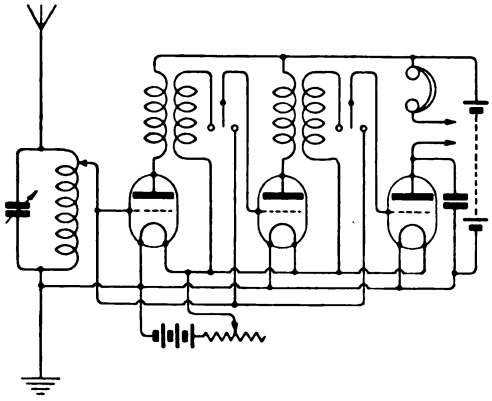

*Fig. 2.*

Without knowing the nature of your switches we cannot give the exact information required, but your circuits might be arranged approximately as in the diagram (Fig. 2).

**"N.L." (Co. Down)** *submits two circuit diagrams, one comprising six valves with resistance capacity coupling, followed by two note magnifiers, and the other a four-valve set with H.F. transformer coupling, all inductances being tuned by means of condensers, and asks which circuit is the better for the purpose of receiving telephony.* (2) *What type of H.F. transformer we should recommend.* (3) *Whether the values of condensers and resistances are suitable for use with "V24" or "R" valves, and what values should be used with "Ora" valves.*

(1) Both circuits will give you very satisfactory results, and the relative merits can only be considered with regard to ease of manipulation. In your No. 1 circuit it is not an advantage to tune both primary and secondary of H.F. transformers, as it makes manipulation very complicated, and the connecting condenser across the secondary of a H.F. transformer drops the potential which is applied to the grid of the next valve. In constructing an outfit to your No. 2 circuit, you should take great care to ensure that the values of condensers and resistances are precisely correct. (2) H.F. transformers of the Sullivan type can be relied upon as quite suitable for use in your No. 1 circuit. (3) The values of condensers and inductances are all quite correct for use with "V24" and "R" valves, these valves having been specially designed for use in the circuits in which you propose to connect them. It is very important that all valves shall be of identical properties.

**"M.H.C." (Wendover)** *submits a plan showing the layout of his apparatus, comprising three inductances and single valve panel, and asks* (1) *Why he is unable to receive signals though the panel itself is O.K., having been tested on another set.* (2) *If the wire as shown by him is correct.* (3) *Whether another variable condenser would be helpful, and if so, where it should be connected.* (4) *What should be the capacity of such a condenser.*

(1) (2), (3) and (4) It is difficult to suggest the cause of the apparatus not functioning correctly, as the diagram you give is quite correct. The addition of a variable condenser having a maximum value from 0·0005 to 0·0015 mfds. and connected in series or parallel with the aerial circuit would be found helpful, as it is quite probable that the range of the tuning coil and the aerial circuit as it stands does not come within that of the closed circuit coil. A condenser having a maximum value of 0·0005 mfds., may with advantage be connected across the reaction coil. As you do not define the actual results given by the set as it stands, we can hardly locate the fault. The variety of valve you use may be the cause of the trouble, as it may be of the slightly soft variety, and require a potentiometer to control the potential of the grid. We think if you make the addition of the condenser suggested, you should have no difficulty in bringing in signals, presuming no internal fault exists on the valve panel, which being of reliable make, we do not look to as a source of trouble.

**"G.A.H." (Farnborough)** *has a number of accumulators which he wishes to lay aside, and enquires what condition they should be in in order that no deterioration may result.*

The cells, whether charged or uncharged, should be completely emptied of acid and filled with distilled water, and allowed to stand for several days. This should then be tipped away and the accumulator left standing wrong way up, in order that all moisture may drain from the plates. When the interior has become dry, the stoppers should be replaced to prevent dust entering the interior.

**"C.H.B." (Fleetwood)** *asks* (1) *For alternative diagram to Fig. 5, page 15, April 1st issue, substituting connections for single slide A.T.I. with reaction.* (2) *If A.T.I., wound on a tube 8½" × 4" with No. 30 S.S.C., is suitable.* (3) *Approximate wavelength of same.*

(1) See diagram (Fig. 3), but an alteration of this nature will quite spoil the set. The remainder of the set as in the diagram referred to. (2) We

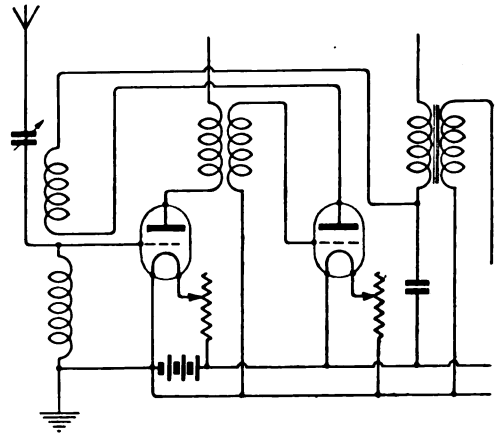

*Fig. 3.*

should prefer a coil of larger diameter wound with thicker wire. (3) Up to 4,000 metres with a normal P.M.G. aerial.

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**"UNCLE TOM" (Bournemouth)** *asks* (1) *For a diagram of a two-valve transmitter for C.W. and telephony.* (2) *Data for wiring transmitter.* (3) *If more valves can be added without dismantling set.* (4) *Values of condensers and resistances.*

(1) See diagram (Fig. 4). (2) It depends largely on the aerial. Try about 40 turns on a former 3" diameter for the A.T.I., and 80 turns on a 2" diameter former for the reaction. (3) Not

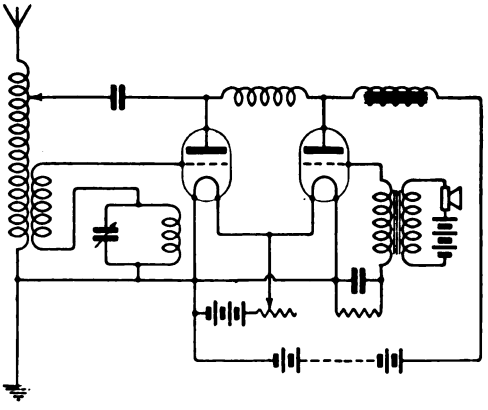

*Fig.* 4.

usefully, except in parallel with the oscillating valve. (4) For grid condenser 0·001 mfds., with 250,000 ohms. Feed condenser try 0·0005 mfd.

**"P.H." (Coventry)** *asks* (1) *Wiring data for a detecting, H.F. and L.F. set of panels, using the same H.F. and L.F. batteries.* (2) *Would single layer coils for short wavelengths and duolateral coils for long wavelengths give a range of from* 250/30,000 *metres.* (3) *Should reactance be used, and if so how wired.* (4) *What valves should be used for the different stages of the multi-valve circuit.*

(1) Many different methods are possible, one of which we give in diagram Fig. 5. (2) Yes. (3) Reactance can be used and will give greater selectivity. For method of wiring, see the diagram. (4) "R" valves may be used throughout, or "V 24" valves for amplifiers and "QX" for rectifier.

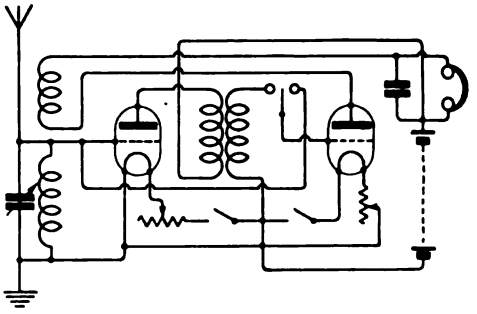

*Fig.* 6.

**"R.J." (Christiania)** *sends a diagram of a circuit for transmitter, and asks* (1) *If circuit is correct.* (2) *How can he add another valve to his single valve receiver.*

(1) The circuit will do, except that for transmission by arc, D.C. must be used with electrodes of copper and carbon. Consult a good text-book, as there are many technical points to be considered before successful radiation can be obtained. (2) See diagram (Fig. 6).

**"J.H.W." (Newbury)** *asks* (1) *For connections for a resistance coupled to L.F. amplifier.* (2) *How to add a panel as H.F. resistance amplifier to a single panel shown.*

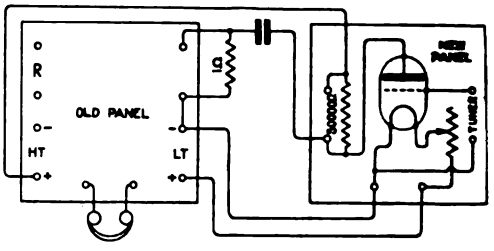


*Fig.* 7.

(1) The connections for a L.F. amplifier are exactly the same as for a H.F. amplifier of this type. but larger values of coupling condenser, say 0·0005 mfd., and smaller values of grid leak, say ¼ megohm, are suitable. (2) See diagram (Fig. 7).

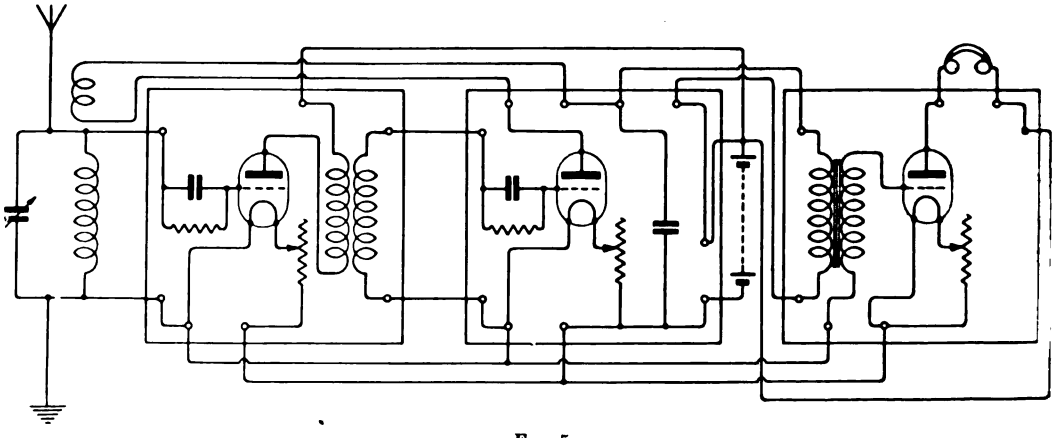

*Fig.* 5.

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**"P.W." (Maidstone)** *asks* (1) *Number of moving plates 2½" in diameter required for construction of condenser having a capacity of* 0·0005 *mfds.* (2) *For a diagram embodying one H.F. amplifier, rectifying valve and one note magnifier, and also dimensions of condenser.*

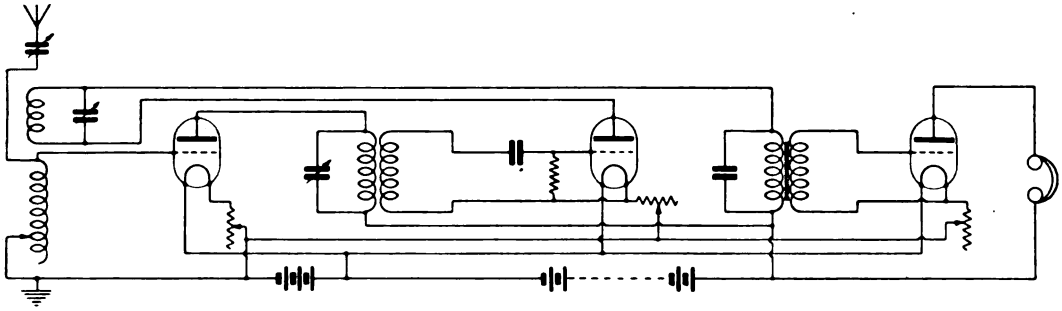

*Fig.* 8.

(1) If the spacing between the successive moving plates is 5.64", and the gauge is No. 20 S.W.G., then ten will be required. From this information you can easily calculate the number required and your spacing washers will be of different dimensions. The thickness of air space in the particulars given above to the thickness that you propose to adopt is inversely proportional to the number of plates required. See Fig. 8. A.T.C., 0·001/0·0015 mfds.; reaction tuning condensers, 0·0004 mfds.; grid condenser, 0·0003 mfds.; the condenser that bridges the primary of the transformer, 0·001; H.T. condenser, 0·01/0·25 mfds. H.F. primary tuning condenser, 0·0003 mfds. maximum.

**"CURIOSITY" (Cambridge)** *asks* (1) *For a diagram of a four-valve set, using a Reinartz Tuner.* (2) *Maximum wavelength a Reinartz Tuner can be made to work upon.* (3) *Formula for calculating the inductance of single layer coils.*

(1) See diagram (Fig. 9) (2) No exact figures are available. We doubt, however, if the tuner would be very much use about 1,500 metres.

(3) L mhys. $= \frac{\pi^2 d^2 n^2 L k}{1{,}000}$.

Where $D$ is diameter of coil in cms., $n$ = No. of turns in cms.

$L$ = length in cms. and $k$ is a constant depending on $\frac{d}{l}$, a few values of which are given :—

| $\frac{d}{l}$ | $K$ | $\frac{d}{l}$ | $K$ |
|---|---|---|---|
| 0·1 | 0·96 | 10·0 | 0·20 |
| 0·25 | 0·90 | 0·50 | 0·82 |
| 0·75 | 0·75 | 1·0 | 0·69 |
| 1·5 | 0·59 | 2·0 | 0·52 |
| 3·0 | 0·43 | 5·0 | 0·32 |

**"P.L." (Teignmouth)** *asks* (1) *What wavelength and system is the* **GFA** *meteorological report and the R.A.F. news sent at* 08.35 *G.M.T.* (2) *Why do some C.W. stations "splutter."* (3) *What is the system which makes its dots and dashes on different notes.* (4) *If* **GBL** *(Leafield) is an arc station, and if so, is the note which fills the spaces between the dots and dashes the carrier wave.*

(1) Formerly 1,400 m., but from 1st July 4,100 m., and in cases of breakdown reverts to 1,400 m. (2) "Spluttering" in a C.W. station is generally due to a badly adjusted arc as generator of the C.W. (3) This is the general method of keying an arc, by changing the wavelength. By suitable tuning one of the notes may be made inaudible, the other is then easily read. (4) Yes, the second note is the spacing wave—quite a different thing from the carrier wave of a telephone set.

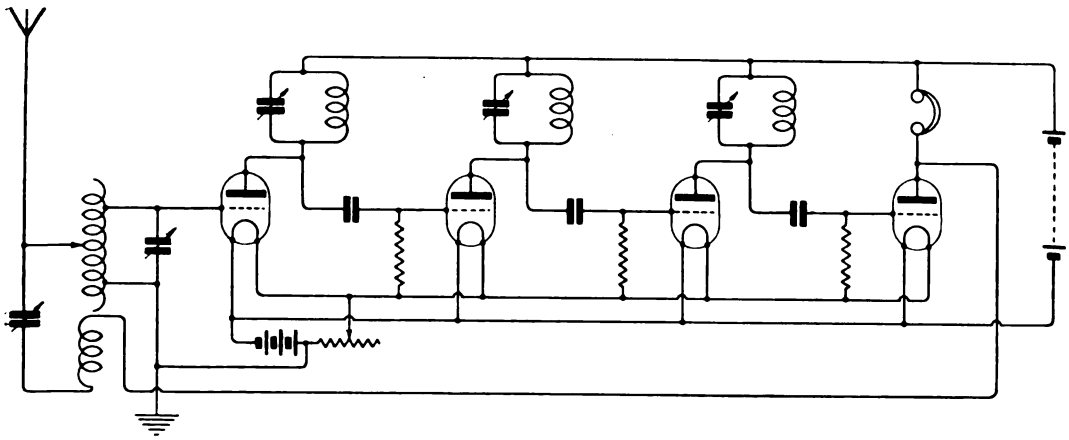

*Fig.* 9.

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**"A.H." (Bradford)** *wishes to purchase wireless receiving outfit, and asks us to advise him with regard to the relative merits of apparatus supplied by various manufacturers.*

It is regretted that we cannot advise you with regard to the relative efficiency of the various outfits you mention. You should, if possible, inspect the apparatus, and if purchasing from a firm of not long standing, a demonstration of the set in use on an aerial similar to your own would help to satisfy you as to its merits.

**"C.W.N." (Wandsworth Common)** *asks for a diagram of a certain two-valve set.*

See diagram (Fig. 10). A set of this type would not be very efficient, and would hardly be worth the complication and expense involved.

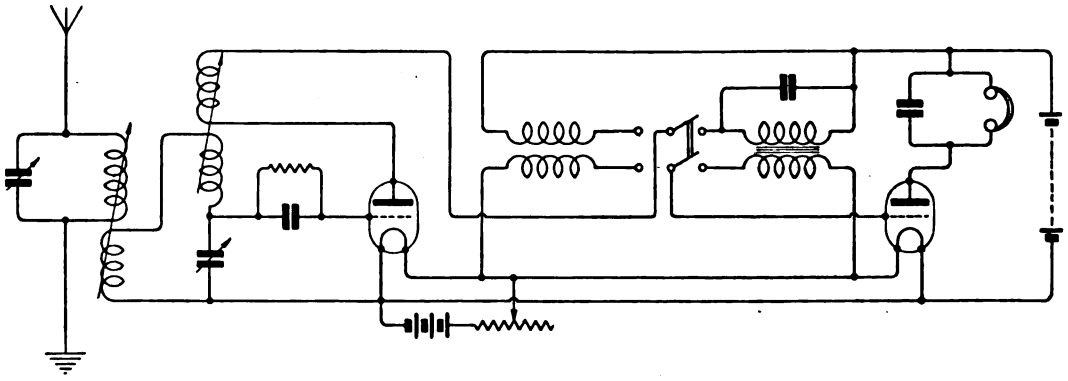

*Fig.* 10.

**"A.T.G." (Whetstone)** *has a loose coupled tuner with primary 6" in diameter by 9" long and secondary 5" in diameter by 7" long, and asks for windings for tuning up to* 3,000 *metres.*

Wind primary with No. 24 D.C.C. and secondary with No. 26 D.C.C., making tappings at ½", 1" 1½", 2", 2¾", 3½", 4½", 5½", 6¾", 7⅞", and 9" on the primary; and at ½", 1", 1½", 2¼", 3", 3¾", 4¾", 5⅞", and 7" on the secondary. This tuner may not work efficiently on wavelengths below 400 metres, for which two special coils should be constructed.

**"H.H.J." (Sydenham)** *has a tuning coil 6" in diameter by 4¼" long, wound with* 220 *turns and tapped for* 10 *turns, and asks* (1) *Whether it would be suitable for the reception of Paris spark signals when coupled to a crystal detector.* (2) *The best type of crystal for use without potentiometer, and* (3) *Should resistance of telephones be* 4,000 *ohms, or whether ones of lower resistance might be used.*

(1) We do not think that your coil will tune to 2,600 metres. It is impossible to advise you as to the wavelength to which a coil will tune without knowing the dimensions of the aerial to which it is connected. In making tappings on a coil, equal distances should not be spaced off. They should be made at increasing intervals along the coil. (2) Silicon and artificial galena used in conjunction with a light iron wire can be recommended, also many of the special crystals at present on the market, particulars of which can be seen in the advertisement columns. (3) A minimum resistance of 4,000 ohms is advisable.

**"K.B." (W.1)** *asks* (1) *How to convert a B Mark II receiver for the reception of short wave telephony.* (2) *Which is the more suitable for the construction of a frame aerial, wire having* 105 *strands of No.* 42, *or single No.* 18. (3) *The capacities of the aerial tuning and grid condensers in the B Mark II set.*

(1) Remove the small tuning coil from the instrument and bring out four leads for the purpose of connecting to two coils which you must arrange external to the set. The 4 megohm leak must also be removed, and the four wires which terminate on one of the leak terminals should be carefully tied together and wrapped with insulating tape. The other lead may be removed from the set. A small circular condenser may also be removed, or at any rate taken out of circuit, but the lead which formerly goes to the coil and from thence up to the valve holders must still be left connected through. Construct two coils as described on page 328 of June 10th issue, and these are connected to the four leads which were formerly joined to the inductance coil of the set. One coil is connected to the lead which passes from the valve holder, and also the right-hand tag of the three when the instrument is viewed from the inside with the filament resistance on the left. The other two tags—that is, the left-hand pair—are connected to the other coil, and when in use these two coils are placed over one another. For short wave telephony reception a condenser having a maximum value of 0·0005 mfds. should be connected in series between the aerial lead and the aerial terminal of the instrument, whilst another of similar value should be connected across the coil which is joined to the plate circuit. (2) The flexible wire would probably be found more suitable, as it will lie closer to the sides of the frame, and it is more easy to arrange strands of flexible wire parallel to one another. If you take the trouble of fixing small pieces of ebonite with spaced holes drilled in them at intervals along the outside of the frame, you may be able to use the No. 18 by passing it through the holes. (3) The aerial tuning condenser would have a value of something less than 0·0001 mfds. This value is not specified, as it is adjusted according to the value of the inductance to which it is connected. This set is not usually fitted with a grid condenser, and the leak which is

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shown across the aerial and earth terminals is for the purpose of flattening the tuning.

"**W.E.P.**" **(Sussex)** *asks* (1) *For instructions as to the best method of constructing a balanced capacity for use in conjunction with his telephony transmitter, and* (2) *Whether there would be any appreciable loss in running the aerial of the earth connections of transmitter and receiver to a double pole change-over switch, together with the aerial and earth leads.*

(1) As you are no doubt restricted as to space, it may be very difficult for you to arrange an efficient capacity. It should consist of a number of insulated wires placed near the ground and running beneath the aerial. For good work you may find that you need at least six or eight such wires, at least as long as the aerial wires, and spaced as wide apart as possible, say a minimum of 8 feet. As your set is installed on the second floor, you might possibly arrange a row of insulators along a distant wall, and run out a number of wires, fanlike. With this lower capacity and big dimensions you will find that by its use you will need to add a few more turns of inductance in the aerial circuit of the transmitter, in order to work on your present wavelength. (2) With a valve transmitter there is no objection to you arranging a china-based switch for the purpose of switching over from transmitter to receiver. There is one variety in which the arms of the switch are well spaced, which is quite suitable. Alternatively you might remove the arms and contacts from the usual pattern switch and remount them on an ebonite base, fitting a new ebonite bridging piece between the two levers, as in many switches at present on the market, this is made of black fibre of uncertain insulating properties.

"**F.J.L.**" **(Plumstead)** *is constructing a two-wire aerial with mid point lead-in, and is unable to bring down the leading-in wires directly from the middle of the aerial, owing to the projecting edge of the roof, which is likely to foul one of the leads, and asks whether equally good results will be obtained if one wire is brought across almost directly to the other, and thence down to the instruments.*

A point to be considered is that an equal length of wire must be in each limb of the aerial up to the point of joining, and as you are unable to arrange this, we would suggest that you join the two aerial wires straight across in the middle, and run you leading wire from the mid point of this connecting wire. If there is still any tendency to foul the edge of the roof, the lead-in wire may be tied back a little out of the perpendicular. What you must avoid is joining together two leading wires of unequal length, or the aerial will prove inefficient, particularly for short wave reception.

"**V.E.C.**" **(Walsall)** *asks* (1) *For dimensions of coils for wavelengths between* 500 *and* 14,000 *metres for use in conjunction with an aerial tuning condenser of* 0·0016 *mfds.* (2) *How many condenser plates are required to give* 0·0015 *mfds. and also* 0·004 *mfds.* (3) *Whether bare copper wire is more efficient than enamelled for aerial construction, and* (4) *Where he can obtain a map of the world showing the location of the wireless stations, also stating the times of transmission and wavelengths.*

(1) It is not possible to advise you exactly as to the number of turns required to tune your aerial to given wavelengths without knowing its dimensions and arrangement. It is quite easy to wind a number of coils of increasing dimensions, and by a very simple experiment you will soon discover the wavelengths to which they will tune the aerial. Then working on, you might make many coils, equal in size to the largest, and by connecting them up in series you can keep on building up until the maximum wavelength range is attained. (2) 30 moving and 31 fixed plates, spacing washer 5/64", plates 20 S.W.G., radius of moving plates 1¼". It would have been better had you stated the dimensions of the plates and washers you can obtain, and then we could have told you the number you would need. (See article on Condenser Construction in issue of August 5th.) (3) Enamelled wire is better, because the enamelling protects the surface and prevents it being broken up by corrosion. Bare wire can, however, be used, and will give quite good results. (4) A map of the wireless stations of the world was formerly published in the "Year-Book of Wireless Telegraphy and Telephony," but owing to the difficulty of including all the stations on one map, it has been subdivided into a number of smaller maps, drawn on various scales. The list of regular transmissions published from time to time by this journal is supplied with the issue of August 5th.

"**C.L.H.**" **(N.W.2)** *asks for windings for an aperiodic resistance, H.F. transformer with optimum wavelength of* 900 *metres. He intends to incorporate the transformer with a seven-valve H.F. amplifier.*

As you will need to make several transformers, it is essential that a design must be adopted which will ensure that all are of precisely the same dimensions, for should one be wound slightly differently, it will filter out signals on wavelengths on which the others function most efficiently, consequently primaries and secondaries should consist only of a single layer, and be wound with No. 44 S.S.C. "Eureka" wire. Both primary and secondary should consist of 650 turns on a 2" former, separated from each other by a single layer of empire cloth. The direction of wire is important, and if both values are made in the same direction, the finishing ends should be taken to grid and plate.

"**H.C.**" **(Manchester)** *asks* (1) *Why he is unable to receive telephony on his single valve receiver, whilst he is able to receive Morse quite strongly from* **FL.** (2) *Number of plates required for constructing an aerial tuning condenser, the moving plates being* 2½" *in diameter.* (3) *The cause of the loud shriek obtained in the telephones while tuning.* (4) *Details for the construction of a H.F. transformer for use on* 200-2,500 *metres, making use of the No.* 29 *and* 36 *wire he has in his possession.*

(1) We notice that you connect your aerial tuning condenser in parallel across the aerial tuning inductance. With the type of condenser you are using, this takes the minimum range of your set well above that on which telephony is usually transmitted. Particulars as to dimensions of aerial would have been helpful in giving you exact instructions, but in any case, your present aerial tuning inductance is too large for short wave reception. You should construct two special coils for short wave work, of about 3½" and 4" in diameter, one turning or sliding inside the other, and having ½" of the winding of No. 24 D.C.C.; or alternatively you might construct coils to the instructions given on page 328 of June 10th issue. It is very helpful



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with short wave work to tune the reaction coil by bridging it with a variable condenser, and the one that is at present connected in your long wave set should be suitable for the purpose. (2) You neither state the thickness of your new condenser plates nor of the spacing washers, consequently we cannot advise you as to the number of plates required, but if the plates happen to be of 20 S.W.G. and the spacing washers 3/32 of an inch, you will require about 24 movable and 25 fixed to give a capacity of 0·001 mfds. You may find it an advantage to build such a deep condenser, and one having similar capacity may be found quite suitable if your aerial dimensions are fairly great, and a smaller condenser, moreover, will permit of finer tuning. (See article on Condenser Construction in issue of August 5th.) (3) This is due to the use of too tight a coupling between aerial and reaction circuits, and the tuning condenser across the reaction coil should permit of critical adjustment to the point where the noise just ceases. A modification of grid condenser and leak may make the reaction adjustment less critical. (4) 200 to 2,500 metres cannot be obtained by the use of one transformer. Using your No. 36 wire, you might construct a transformer having 280 turns each for primary and secondary, of mean diameter of 1½", the two windings being separated by a wrapping of insulating material. The one that is connected in the plate circuit should be bridged with a small variable condenser. The direction of winding is important, and if your transformer is wound in a groove, the two windings should be in opposite directions, and the end of the primary and the beginning of the secondary—that is, the two leads that pass out between the windings—should be taken to grid and plate.

**"J.E.L." (Letchworth)** *asks for a diagram of a three-valve circuit comprising one H.F., one detector, and one L.F., suitable for the reception of telephony, and in particular* **PCGG, 2 MT, 2 LO,** *and Croydon, and sufficiently strong for operating a small pattern Brown loud speaker. A circuit diagram is submitted, and it is stated that it is very difficult to obtain strong signals with a loud speaker.*

Your circuit would appear to be in every way satisfactory, except that perhaps you might get better results by connecting the aerial tuning condenser in series with the inductance, which will permit of the use of more turns in the A.T.I, and consequently a bigger potential will be bridged off. You did not describe the construction of the H.F. transformer, and it may be in this instrument that inefficiency arises. The two windings should not be put on simultaneously, but should be separate and insulated from one another, and with this form of construction it is an advantage to bridge the primary winding with a small value variable condenser. The direction of winding is important, and if both primary and secondary are wound in the same direction, the finishing ends should be taken to grid and plate, and the beginning ends to H.T. plus and L.T. minus of the potentiometer. The detector valve should be of such a type as will give efficient rectification, and one of the slightly soft variety, or a "Q" controlled with a potentiometer may considerably improve your results. It is an advantage to loosely couple the aerial inductance with a secondary inductance, which is taken to the first valve grid and L.T. minus, and if this is done, the variable condenser should be connected in series with aerial circuit, and another connected across the secondary winding. Although you complain that the results you obtain are not entirely satisfactory, we do not think it easy with your equipment to obtain signals from **PCGG** sufficiently strong for the operation of a loud speaker.

## SHARE MARKET REPORT.

Prices as we go to press on August 11th are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 6 | 7½ |
| ,, Preference .. .. | 2 | 8 | 6 |
| ,, Inter. Marine .. .. | 1 | 8 | 9 |
| ,, Canadian .. .. | | 10 | 10½ |

Radio Corporation of America:—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | | 19 | 3 |
| Preference .. .. .. | | 13 | 9 |

### Marconi Annual Report.

At the Annual General Meeting of Marconi's Wireless Telegraph Company, Ltd., held on August 15th, the report of the directors and statement of accounts were rendered for the year ended December 31st, 1921.

It was pointed out that owing to the many matters which still remain unsettled, the accounts once more do not reflect the true strength of the Company's position.

The Credit Balance of Profit and Loss Account for the year amounted to £275,361 7s. 8d., which, added to the balance brought forward from the last account, leaves to the credit of Profit and Loss Account a sum of £1,093,928 9s. 11d., subject to Corporation Profits Tax and Income Tax. From this have to be deducted the following dividends:—On Preference Shares, 7 per cent. paid on January 31st, 1922, £17,500; on the Ordinary Shares an interim dividend of 5 per cent. paid on January 31st, 1922, £131,555 3s. 7d., together making £149,055 3s. 7d., leaving available for distribution a balance of £944,873 6s. 4d.

The directors recommended payment of further dividends for the year ended December 31st, 1921:—On the Ordinary Shares, 10 per cent. (making 15 per cent. for the year), £265,543 0s. 10d.; on the Preference Shares, 5 per cent. (making 12 per cent. for the year), £12,500, together making £278,043 0s. 10d., leaving a balance to carry forward to next account of £666,830 5s. 6d.

### W. T. Henley's Dividend.

The directors of Messrs. W. T. Henley's Telegraph Works Company, Ltd., Blomfield Street, London Wall, E.C.2, have declared a dividend on the Preference Shares at the rate of 4½ per cent. per annum, less Income Tax, for the half-year ended June 30th last. Also an interim dividend on the Ordinary Shares of 1s. per share, less Income Tax, both to be paid on September 1st next.

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THE
WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
VOL. X. No. 22. AUGUST 26TH, 1922. WEEKLY

# A Broadcast Receiver

By A. J. BULL.

I SUPPOSE that during the last few weeks quite a number of people associated with the technical side of wireless telephony have been rung up by telephone and a conversation similar to the following has taken place:

"Hullo Brown! Good morning! I hope that your cold is better." "Good morning! Yes, thank you" (and mutters to himself, "Now how on earth did he know that I had had a cold? I haven't seen him for a year.) Well! What can I do for you?"

"I want your advice about the construction of a valve receiver which will enable me to pick up all the broadcast stations, and also the Dutch concert on a very poor aerial.

"As I already possess a few odd parts from ex-service apparatus, I would like to build the set myself, and make use, if possible, of those parts. I want really a first-class instrument, but cash being limited, I should like to build the set up gradually, and to commence receiving signals from the moment I purchase the first valve. At the same time I would like the finished instrument to be complete in itself, excepting of course for the H.T. and L.T. batteries."

"Righto, Jones. I will see what I can do for you."

* * *

It is the intention of the writer of this article to give details and working particulars of a three-valve amplifier, which can be built up by anyone from odd component parts that are at present available at dealers of second-hand and new apparatus; and at the same time to produce a finished instrument of high efficiency which will enable experimenters to receive from various broadcasting stations that may be erected in the British Isles, and also from some of those on the Continent.

*In the design of the instrument provision is made for reaction, but since it is understood that reaction for broadcasting receivers is likely to be prohibited by the Postmaster-General for wavelength ranges up to about 500 metres, it should be borne in mind that provision is made for the reaction terminals of the instrument to be bridged across by a brass strap for reception on these wavelengths.*

Although the finished design is that of a three-valve instrument, there is no need to complete the instrument before experiments in the reception of signals can be commenced.

Provided that the dimensions of the box and consequently that of the ebonite panel is adhered to, one valve and its circuit (Fig. 2a) can be built in the panel as shown in Fig. 2b. This single valve circuit, with the addition of an aerial, etc., of course, will enable the owner to become acquainted with the doings of the nearest broadcast station.

With the introduction of the second valve and its wiring, additional experiments are of course rendered possible, and finally, with the inclusion of the remaining valve, simultaneous H.F. amplification, detection, and note magnification become available.

To those who wish to commence operations immediately with a single valve, and desire to possess a three-valve instrument complete in itself ultimately, and not made up of a number of units which have to be wired together to function as a single instrument, this design should prove of special interest.

The finished instrument, as shown in the photograph (Fig. 1), will also be found useful to the keen experimenter who desires to instantly compare methods of reception, or to demonstrate the advantage of employing

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a particular method when receiving from a certain station.

For instance :—

Supposing the experimenter's station is situated about 100 miles from the Marconi telephony station (**2 MT**) at Writtle; by operating the switches provided on the instrument whilst this station is transmitting, radio frequency and audio frequency amplification can be compared, the advantage of reaction, and the disadvantage of carrying reaction too far demonstrated, etc., also strength of signals can be noted with one, two, or three valves in circuit.

The following table indicates the position of the switches for valves in use :—

| H.F. Valve | Detecting Valve. | L.F. Valve. | Position of Dewar Swith. | Two-way Switch turned to |
|---|---|---|---|---|
| | Detecting Valve | | Up | Right |
| | Detecting Valve | L.F. Valve | Neutral | Right |
| H.F. Valve | Detecting Valve | | Up | Left |
| H.F. Valve | Detecting Valve | L.F. Valve | Neutral | Left |

When reaction is required the strap short circuiting the reaction terminals is opened.

The circuits employed (Fig. 3) are well known and therefore need no explanation. The condenser used (0·0005 mfds.) in the H.F. circuit, is perhaps rather larger than that usually employed for the purpose, but inductances for the most important waves to the experimenter, possibly the broadcast waves, can be suitably constructed, or purchased, which will permit of the condenser functioning somewhere near its minimum value. The advantage of the larger condenser over that more commonly employed, viz., 0·0001 mfd.) will be found when it is desired to receive wavelengths above 2,500 metres, as the wave

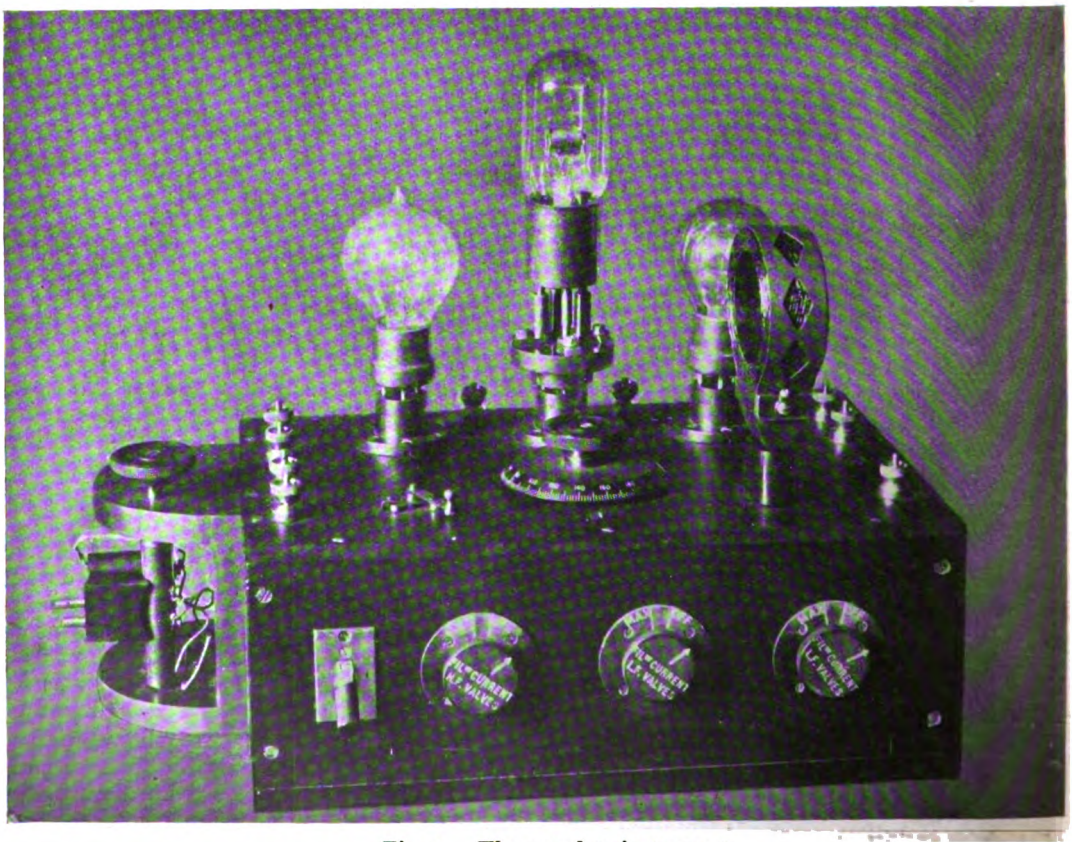

*Fig. 1. The complete instrument.*

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range of each coil is considerably increased. For example, Igranic coil No. 600, of 19,700 microhenries inductance, tunes, with a 0·0001 mfd. condenser, from 2,500 to 4,200 metres approximately.

By a simple calculation, viz., $\lambda = 1885 \sqrt{LC}$ where $L$ is in microhenries and $C$ in microfarads, it will be seen that the range of this coil is increased with a 0·0005 mfd. condenser, to 5,830 metres approximately, and the loss in efficiency due to reactance of the condenser with these lower frequencies is scarcely noticeable to the experimenter.

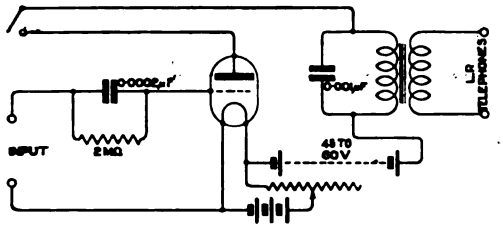


*Fig. 2a. Simplified connections of single valve circuit with switch to short circuit reaction leads.*

ORIGIN OF SEVERAL OF THE PARTS EMPLOYED IN THE INSTRUMENT.

As has already been stated, it is intended that this instrument shall be made up of component parts which are available at dealers, or which amateurs may already possess, and so a brief description of some of the parts from which the set shown in the photograph was constructed by the writer will now be given.

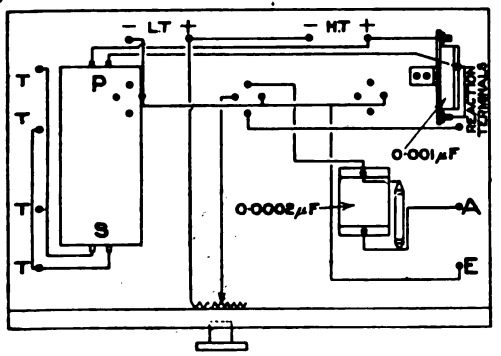


*Fig. 2b. Single valve wiring diagram.*

The filament resistances and valve holders were originally designed for a R.A.F. d.f. amplifier, and purchased very cheaply. The H.F. condenser and twelve terminals are from the well-known Mark III receiver. The 0·001 mfd. fixed condenser across the intervalve transformer once did duty in a heterodyne wavemeter.

The switch which can be seen on the front of the instrument is an ordinary land-line telephone listening key, sometimes described by dealers as a "Dewar" switch.

The reader should now have the impression that no particular make of parts is essential. Some makes are, of course, preferable to others, owing to their better design and mechanical construction.

When purchasing component parts it is advisable to have the full size design (given on the next page) and dimensions of the panel (Fig. 4) at hand, so that the dimensions of various parts may be checked. Sufficient space, however, has been allowed for any moderate variation in size of the parts that are likely to be offered to the experimenter.

After the various parts have been got together, the wooden box should first be constructed. This is made of $\frac{7}{16}$ in. material and measures outside $12\frac{1}{8} \times 7\frac{7}{8} \times 4\frac{7}{16}$ ins. in height, the front being screwed on by means of four suitable 1-in. brass screws. The ebonite top to the box should next be prepared.

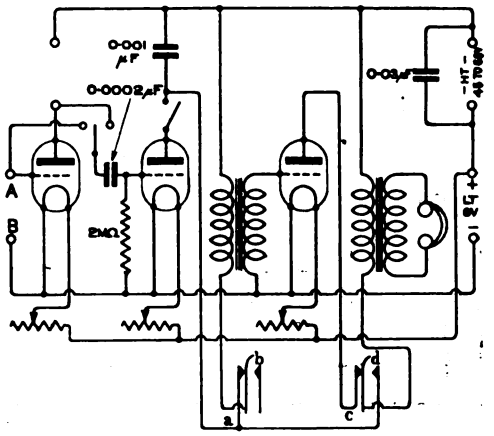


*Fig. 3. Simplified circuit diagram.*

This should be unpolished, $\frac{1}{4}$ in. in thickness, and secured in position by ten 1-in. brass screws Consideration must now be given to full scale design and any alterations made to the design which may be considered necessary, owing perhaps to difference in size of one or two of the component parts purchased, to the dimensions shown in the diagram. It may be anticipated that the transformers will vary in size, and also that the diameter of the holes in the front of the box through which the three

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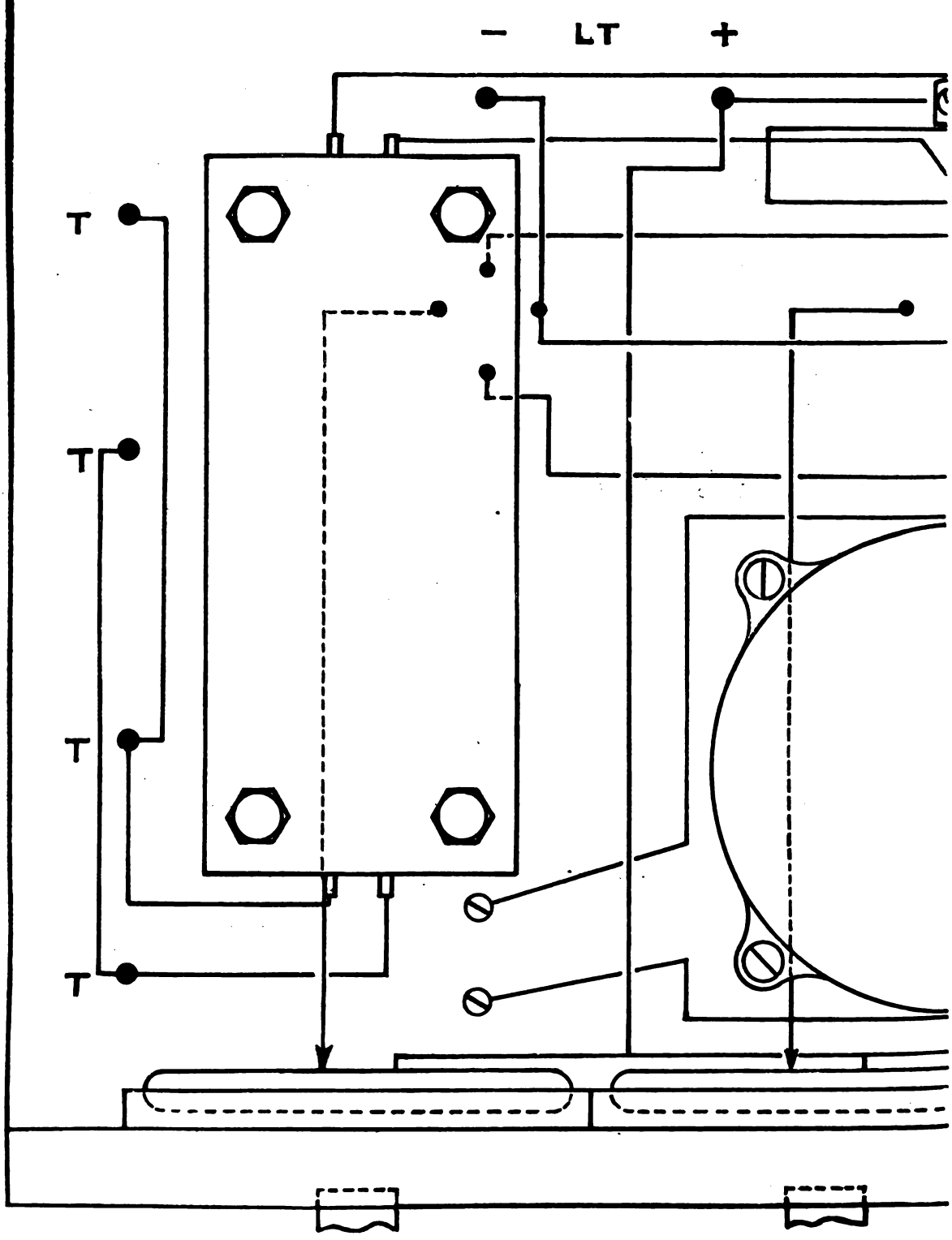


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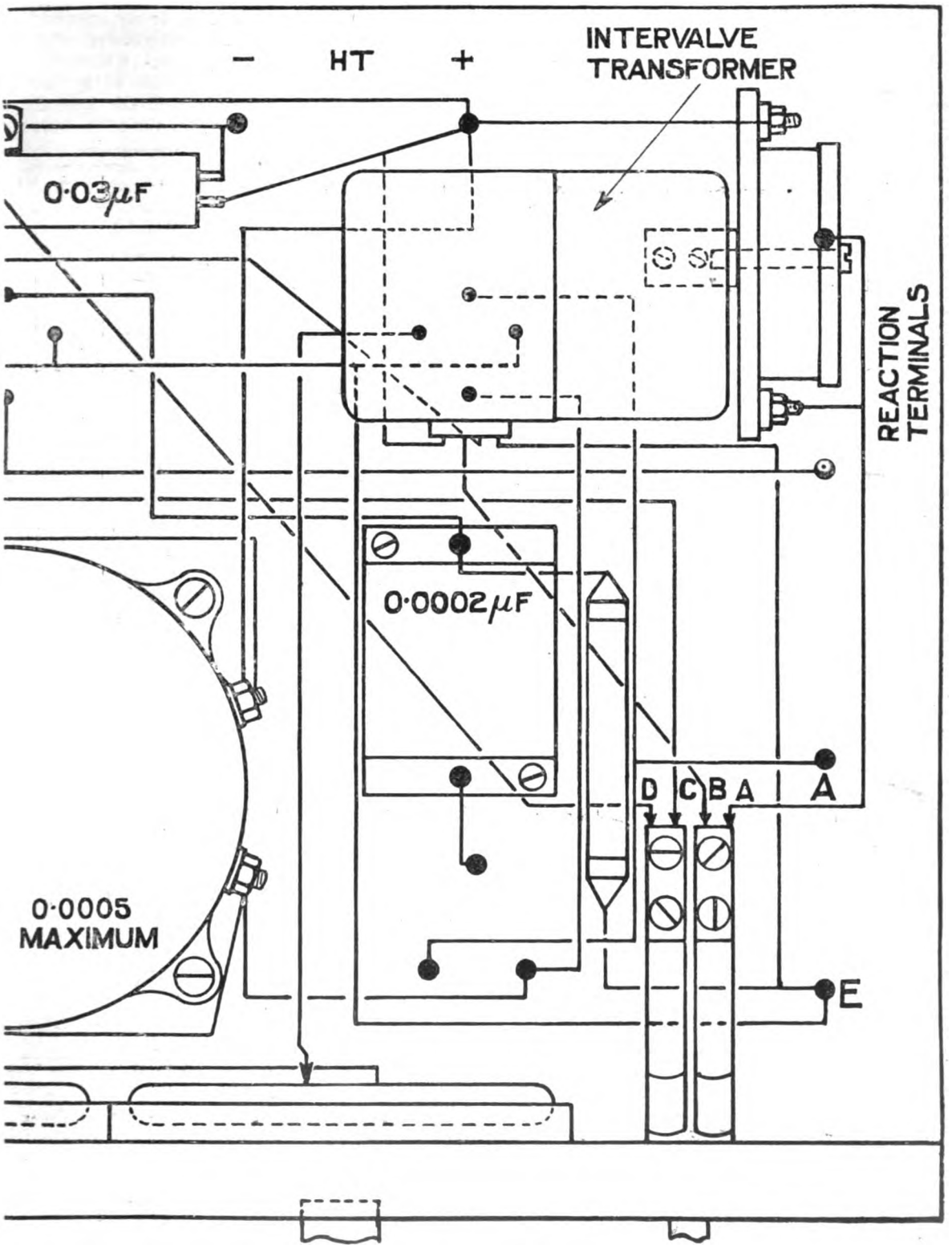


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filament spindles pass, may vary in diameter, but these slight alterations should not present any difficulty. The ebonite panel can now be unscrewed from the box and the position of all holes marked ready for drilling on the underside of the ebonite.

should be taken that there is no stretching or shrinking of the paper. After the necessary drilling has been done, the panel can be laid aside for a moment. The front of the box should now be unscrewed and the hole cut to receive the Dewar switch, and the three

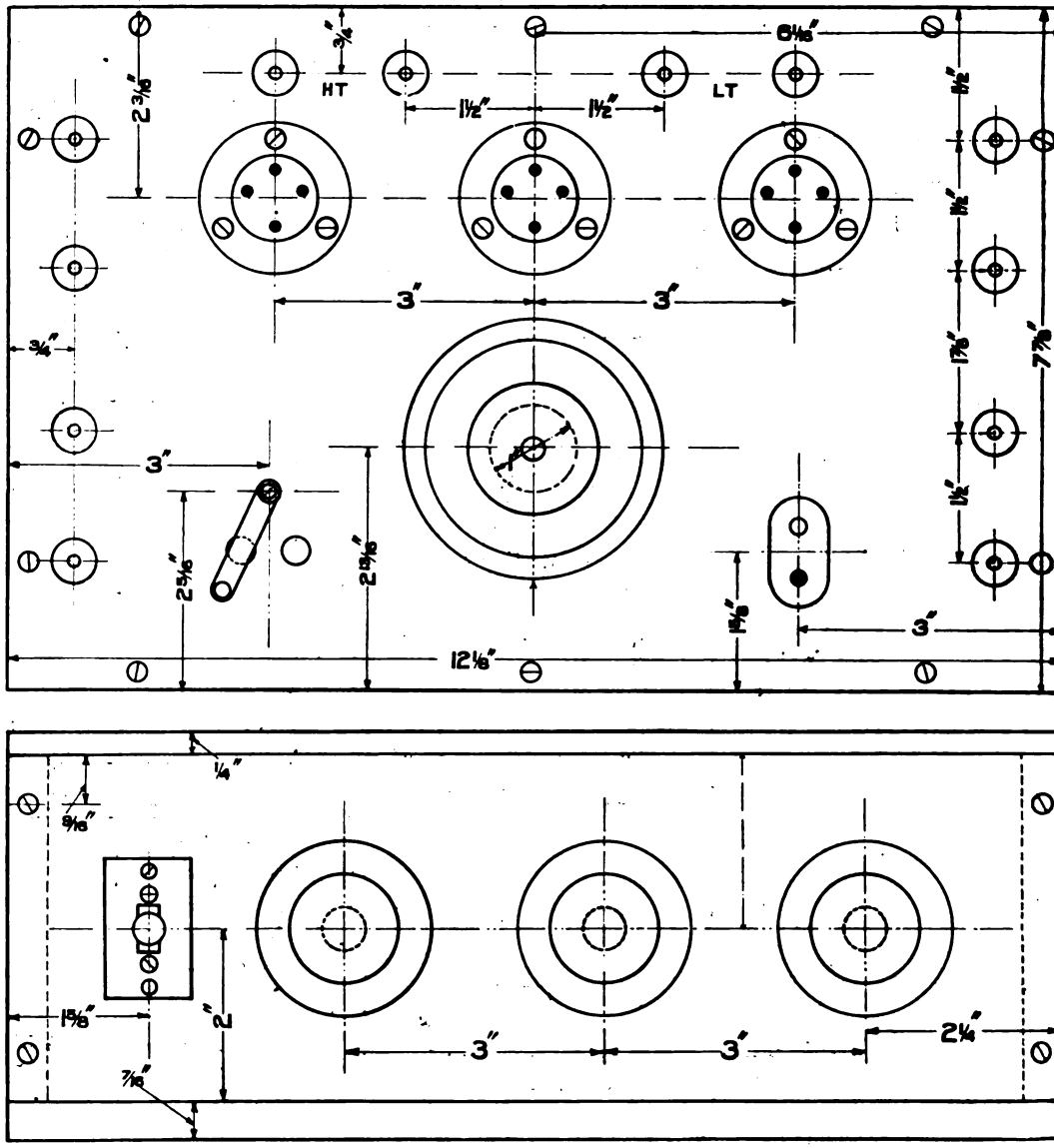


*Fig. 4. Dimensions of the panels (top and front).*

*The design on pp.* 680-681 *is drawn full size. If a copy of this diagram is carefully gummed to the underside of the ebonite panel, the position of all holes to be drilled, and also the disposition of wiring, etc., is clearly defined,* but great care

holes drilled for the reception of the filament spindles. The next step is to screw the complete filament resistances and Dewar switch in their respective positions, and fasten the ebonite panel to the *front* of the box *only* by

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three 1-in. wood screws. By means of nine 4 BA screws, ½ in. long, the three valve sockets are secured in position. For the drilling of the holes a 7/64-in. drill is recommended, and if a 4 BA tapered tap is not available, each screw may be made to cut its own thread in the ebonite. This method gives quite satisfactory results. It is advisable at this stage in the construction of the amplfier to wire the filament circuits. This should preferably be done with tinned bare copper wire of about No. 20 gauge, as there are a number of soldered connections to be made. A good method to follow with the wiring is to bend each wire to the shape required and then pass the insulation over the wire. This insulation is commercially known as sleeving, and costs about 4d. per yard. It is in the form of a tube and fits closely over the wire.

Here a word of caution is earnestly given. Do not rush the wiring. It does not pay. Any extra time spent in wiring and in the disposition of the various parts is time well spent. Space the wires as far apart as is consistently possible, so as to reduce to a minimum the capacity between one wire in one circuit and another wire in another circuit. If this is not done inter-oscillation between the circuits may result.

(*To be continued.*)

# Valve Manufacture

## A BRIEF DESCRIPTION OF THE SIMPLER PROCESSES ADOPTED IN THE MANUFACTURE OF M.O. VALVES

(*Continued from p. 647, Aug. 19th, 1922.*)

THE dimensions of the electrodes are of considerable importance, both with regard to characteristic and rating, and in the case of transmitting valves of definite watt rating, the energy that can be handled is approximately calculated on the basis of the ratio of the rated watts to the anode area.

The disposition of the anode with regard to the container, the leads and the pinch, requires considerable attention in valve design, and also the length of anode with regard to length of filament must be carefully considered, in order that even heating may result over the whole anode during bombardment. The grid dimensions and spacing are calculated to maintain definite characteristics in specified operating conditions, and in the case of transmitting valves the spacing may be varied throughout the length of the grid, according to the extent to which it enters the field of electronic action. The filament diameter and length are calculated on the basis of the emission required at a temperature which allows of a reasonably long life, allowance being made for the cooling at the ends and a certain decrease in diameter which occurs during bombardment.

The sealing-in of the mounted electrodes is effected by the use of a special machine, and great attention is required with regard to the annealing of the glass. In the case of small receiving valves, the point of sealing is annealed by placing the sealed end of the bulb in a gas-heated asbestos cup, which is allowed to cool down by slow stages, but the seaming end of the tube is next melted into the body of the bulb by attaching it to the exhaust system on the pumping tables.

After the bulbs have been fitted with the interior electrodes, they are given a preliminary exhaust and sealed off. Those which prove to be free from leaks are later sealed on to the glass tubing which forms part of the exhaust system on the pumping tables, and a control cock is so turned for a sufficient length of time to obtain the first degree of vacuum. The cock is then turned to another position, when the table exhaust system is arranged in three stages, *i.e.*, mercury diffusion pump, rotary oil-box pump, and motor-driven reciprocating pump. The latter is backing the box pump to a pressure of 1 mm. The box pump is in turn backing the diffusion pump to a pressure of 0·001 millimetres, and the diffusion pump is capable of reducing the pressure in the valve to something below 0·000001 mm.

The pressure is indicated by the McLeod gauge. A liquid air trap is placed between the high vacuum side of the diffusion pump and the valves undergoing exhaustion, to prevent the possibility of mercury vapour

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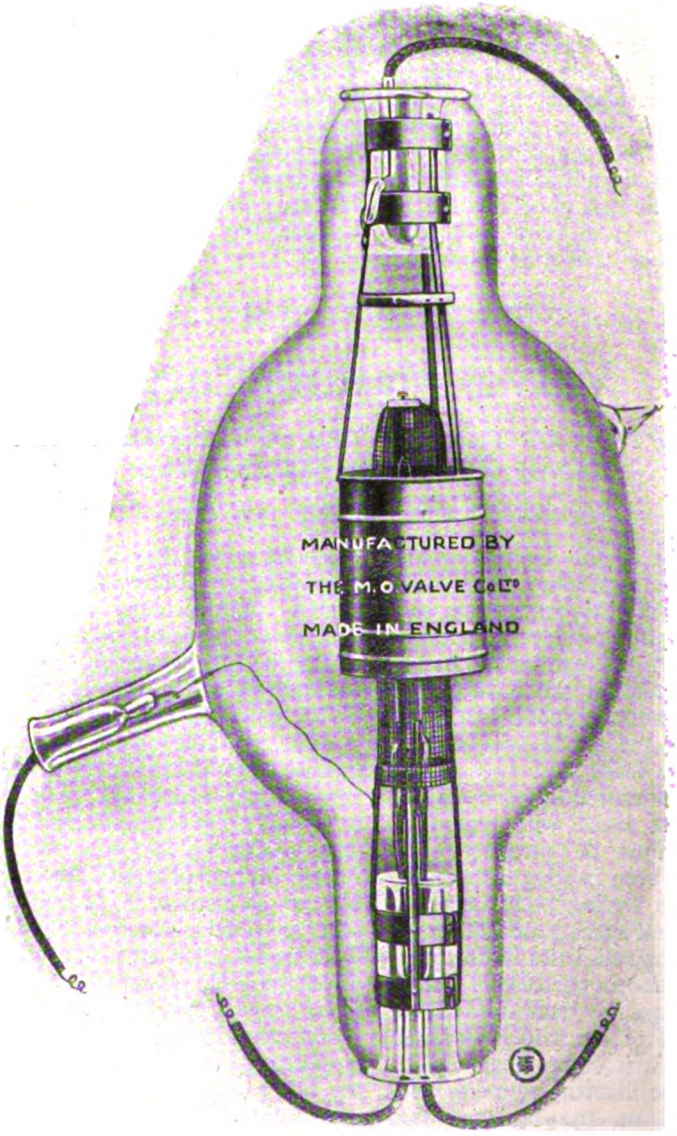
getting back into this part of the system. Electrical or pressure tests are applied to determine the exact condition of the valve during exhaustion. The current in the valve grid potential, the extent of which is a clear indication of the pressure in the valve and of any evolution of gas from the heated electrodes. This test is not carried out




*Transmitter type M.T.6. Designed to operate with anode potential of 10,000 volts and dissipating 400 watts.*

anode circuit is adjusted so that the energy dissipated would be the amount that would be desired to test the valve. This current is kept constant by increase and decrease of while the valves are still connected to the pumps, because in this case the gas would be cleared by their action as it was evolved. The test is applied by dissipating a definite wattage

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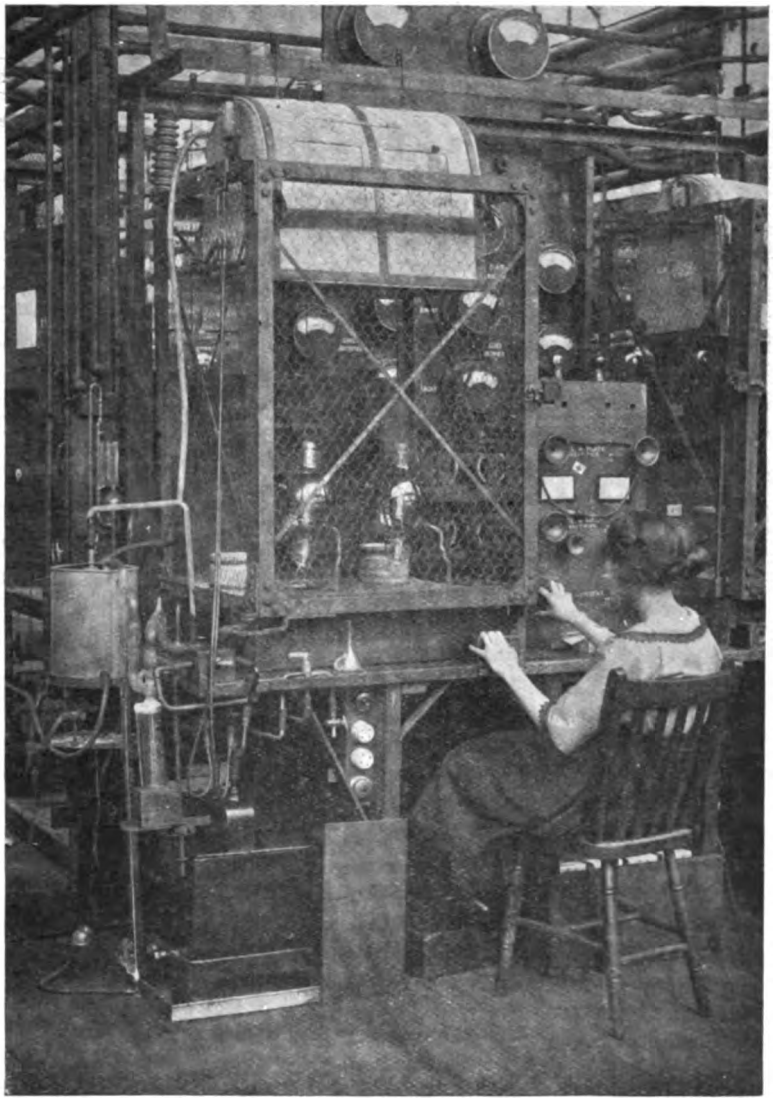
in a specified time, and then comparing the gauge readings at the beginning and end of the test, which will, of course, show the amount by which the pressure has increased during that time owing to the evolution of gas. When the required degree of vacuum has been obtained, an oven is brought down over the valves and left there until a suitable temperature is reached. The gas heater is then turned off and the oven allowed to cool down to a definite temperature, when it is removed and the valves again connected up to the several terminals on the inside of the cage, thus connecting anode, grid and filament to their respective circuits, after which the cage is placed in position, and then bombardment can be commenced. This is done slowly and with great care, the operator



*Large Transmitting Valves being exhausted. The pumps are on the left and the remote control switch on the right.*

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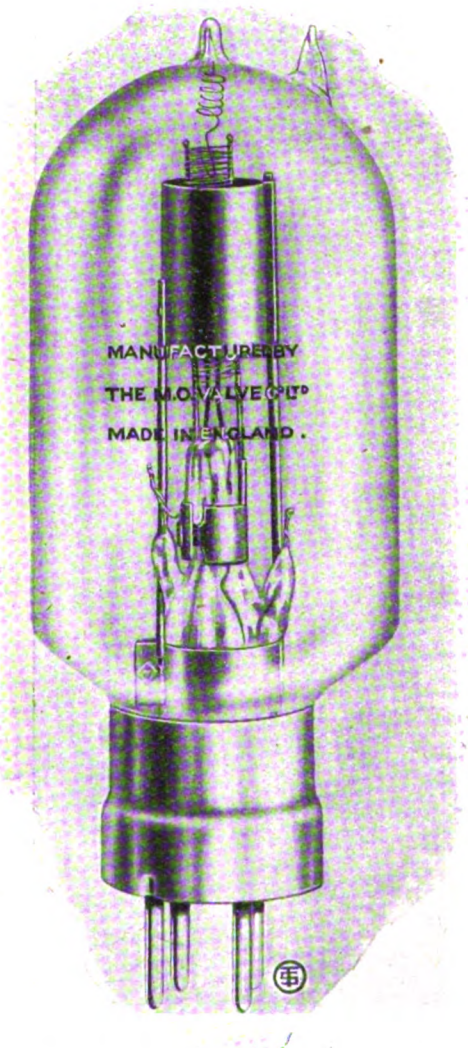
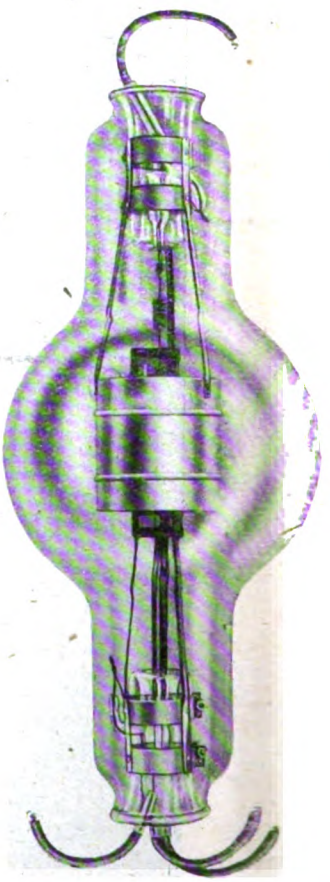
watching for the appearance of the blue glow indicating ionisation. In the early stages of bombardment, the blue glow will appear before there is any visible sign of the anode preliminary bombardment. The process is then repeated, commencing again with the first valve, until it is found that the glow is accompanied by visible heating of the anode.




*Type T30. A low power Transmitting Valve dissipating 30 watts.*



*Type T250. Requires an Anode Voltage of 2,000, and dissipates ¼-kW. Overall length 280 mm.*

heating. As soon as the glow appears, the filament current is reduced to zero, and the next valve proceeded with in a similar manner, and so on until the entire batch which the operator is manipulating has received this Experience alone on the part of the operator can show how long it is safe or wise to allow the filament current to be maintained while there is blue in the valve. Two things may occur: either a rapid increase in ionisation, resulting

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in a flash over between anode and filament which would destroy the valve, or a serious wasting of the filament due to bombardment of positive ions. Even an experienced operator may produce valves which, though being good as far as vacuum is concerned, may have their filaments wasted to such a degree as to cause them to be rejected on subsequent tests, on account of the required filament voltage being too high. Further, it is clear that if this did not happen to be the case, such wastage would result in a short life for the valve in service.

Before completing the bombarding process and sealing off, the valves may again be heated in the oven to further ensure the absorption of all the available gas from the glass.

The operation of sealing off after bombardment is one that requires skill and care. It will be realised that in the baking process the glass cannot be brought up to its softening-point on account of the low pressure inside the bulb, and consequently there is a comparatively large amount of gas in the glass, which is not released during the process, so that when the blowpipe is applied to the sealing tube to seal off, gas will be liberated, and if a careless operator heats a larger surface than is absolutely necessary, or prolongs the operation for too long a time, the pumps will not be able to clear the liberated gas quickly enough, and so it will be sealed inside the valve, so that it will not pass the subsequent tests.

The electrical equipment used in valve manufacture is one provided with a large range of voltages in both alternating and continuous current, ranging from 10 to 20,000 volts, for the purpose of supplying anode, grid and filament potentials, and for operating the usual indicators, lamps and automatic switch gear.

The careful testing of valves is of the utmost importance. Tests are made to determine the emission for a given filament-current, filament-plate-current, filament-grid-current, and plate-current for given fluctuations of grid potential. The valve is also carefully scrutinised as to the concentric arrangement of the electrodes. As mentioned earlier, only those valves are passed which come within certain specified standards, which allow of only a small deviation from the prescribed characteristic. This assures that all valves of a particular type can be relied upon to have certain properties and be interchangeable with one another—a very important property to valve users. It is this extreme care in testing that assures one that a particular valve can be relied upon to function correctly in a particular circuit, and for the purpose for which it is required, and the M.O. Valve Company, fully appreciating the importance of the standardising of the various types of valves, have laid down an extensive and elaborately equipped Test Room. Every valve during manufacture bears a registered number, and records are kept showing the results given on test.

The next and last stage in manufacture is the fitting of the cap with, in the case of the "R" valve, a four-pin socket. The capping and the soldering-off of the valve leads is executed with the same care that is shown in the other stages of manufacture, and in this case with the object of maintaining insulation during soldering and the correct spacing of the leads in the socket. The valves are then marked with type number and manufacturing details, and are ready for the market.

Particulars are given below of the more familiar types of valves manufactured by the M.O. Valve Company, Ltd. The purposes for which the various valves are suited is too wide a subject to enter into here, but a few brief notes on the action of the more important receiving valves may be helpful.

The "R" type is the well-known French form of valve, and is extensively employed for general reception purposes. It gives good results as a detector, L.F. amplifier, or oscillator, and is one of the best all-round valves for use where it is not desired to employ a special type for a specific purpose.

The "R.4B" is intended for use as a detector or for low frequency amplifying. It has a long life, and its filament voltage is well within the capacity of a 4-volt accumulator.

The "R.4C" is very similar to the "R.4B" and operates on the same filament and anode voltages, but has a slightly more open grid and lower impedance. It gives silent amplification, and has a long life.

The tubular "Q" valve is for use chiefly as a rectifier, though it can be used as an amplifying valve and for all general receiving work.

The "QX" is an efficient rectifier, and is also employed as an amplifier after several stages of H.F. amplification. It is also suitable as an oscillator.

The "V.24" is intended chiefly for use as an amplifying valve, both at high and low frequency, and also as a low-power oscillator.

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The " F.E.1 " is a four-electrode valve.

Particular reference should be made to a new type of valve which has been developed by the M.O. Valve Co., in conjunction with the Research Laboratories of the General Electric Co., the great advantages of which will be apparent to every valve user. In the case of an ordinary " R " valve the filament is run from a four-volt accumulator, and takes a current of about 0·7 amperes. The new valve has a special filament, not of the coated type, which requires something less than 2 volts on the filament, while the current is in some cases as low as 0·06 amperes. Valves of this type, it is understood, are almost ready to be put on the market in large quantities, the first production in all probability being valves running at 1·8 or 2 volts with a filament current of say 0·06 to 0·1 amperes. It will be apparent that these valves can be run from small dry cells.

A description of valve manufacture would not be complete without making mention of the enormous amount of research work which has been conducted by the M.O. Valve Company, so that they are now able to place such highly efficient valves on the market. The credit of tackling the problem of the thermionic valve in the proper way and manufacturing in quantity belongs to them by right undisputed, particularly during the War. This work—one of those aspects of war work almost unknown to the public—had a very direct bearing upon the result of the struggle, as valves could only be manufactured in a factory where there were already highly skilled workers accustomed to the intricacies of incandescent lamps, and it is very doubtful whether we should have been able to hold our own in the under-sea warfare, and to carry on the war in the air with anything like success, without the resources of this company being at our disposal.

*A Test Bench where Valves are examined and data recorded.*

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*We are indebted to the General Electric Company, Ltd., and Marconi's Wireless Telegraph Company, Ltd., for assistance in the preparation of this article and the loan of the illustrations of the various valves.*

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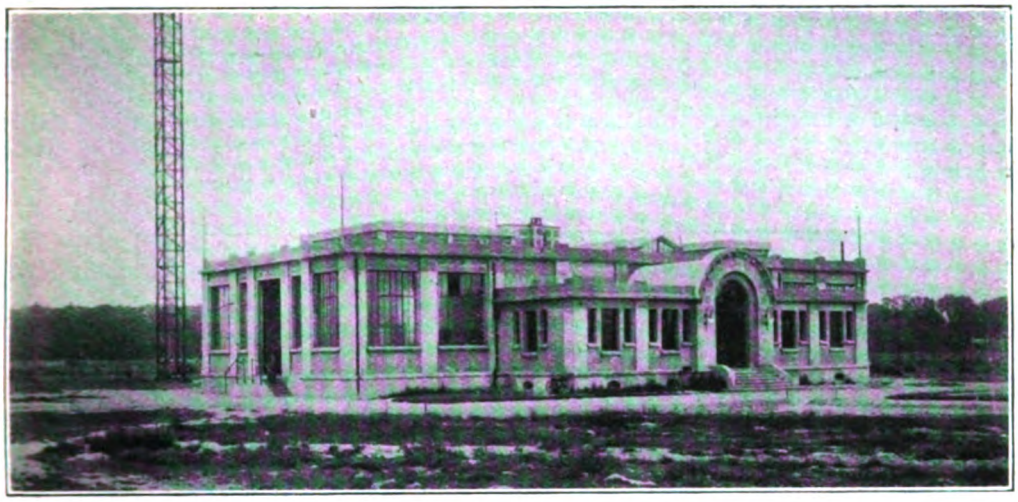

*Fig. 1. The station building of the Continental transmitter.*

# The Trans-Continental Wireless Station of Sainte Assise

THE foundation stone of the wireless station of Sainte Assise, known as Paris Radio Central, was laid on January 9th, 1921, and the first message was transmitted from this station on the morning of July 4th, 1922, at 11 o'clock G.M.T.

The station called up Marion, U.S.A., on a wavelength of 14,300 metres. Communication was immediately established, and hand operation was then replaced by high speed automatic transmission.

During the afternoon, Senatore Marconi, from his yacht *Elettra*, in the neighbourhood of New York, reported excellent signals. A further telegram of congratulations after more detailed observations, was sent by Senatore Marconi on the following day.

Since that date, observations from all parts of the world signify to the very high efficiency of the station. Sainte Assise was formally opened on August 17th, 1922.

Previously, the wireless station of Croix d'Hins, near Bordeaux, which was opened at the end of 1920, has claimed the honour of being the most powerful wireless station of the world. The power of the new Sainte Assise station, however, now eclipses that of Bordeaux, the Paris station being about twice as powerful.

The Compagnie Générale de T.S.F., who have constructed and who now operate the station, have carried out the work on a grand scale. The site of the station is on the plateau of Sainte Assise, about twenty-five miles from Paris (Fig. 2). The area covered by the station is bounded on the north by the road from Seine Port to Sainte Leu, on the south and west by the Seine, and on the east by the railway from Melun to Brunoy. The site is approximately level, and the soil is sufficiently moist at all times to ensure an efficient earthing system. Many conditions were laid down by the French Ministry of Posts and Telegraphs when the erection of the station was sanctioned, and it was some time before this site was selected which would comply with them all.

There are two main buildings which serve to house the station, and these are occupied as follows :—

(1) Two valve transmitters of 5 kW. each, for short distance communications, the aerials being supported on a tower about 330 ft. high.

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(2) A "Continental" station (Fig. 1), consisting of four high frequency alternators with an aerial input of 25 kW., for European services.

The aerial, which is of the "double cone" type, consists of four independent networks, and is supported by a single tower 830 ft. in height.

may also be used independently for duplex transmissions.

(3) An "International" station, consisting of two 500 kW. high frequency alternators and two of 250 kW. each.

In this case the aerial consists of a double network suspended horizontally by sixteen towers, each 830 ft. high.

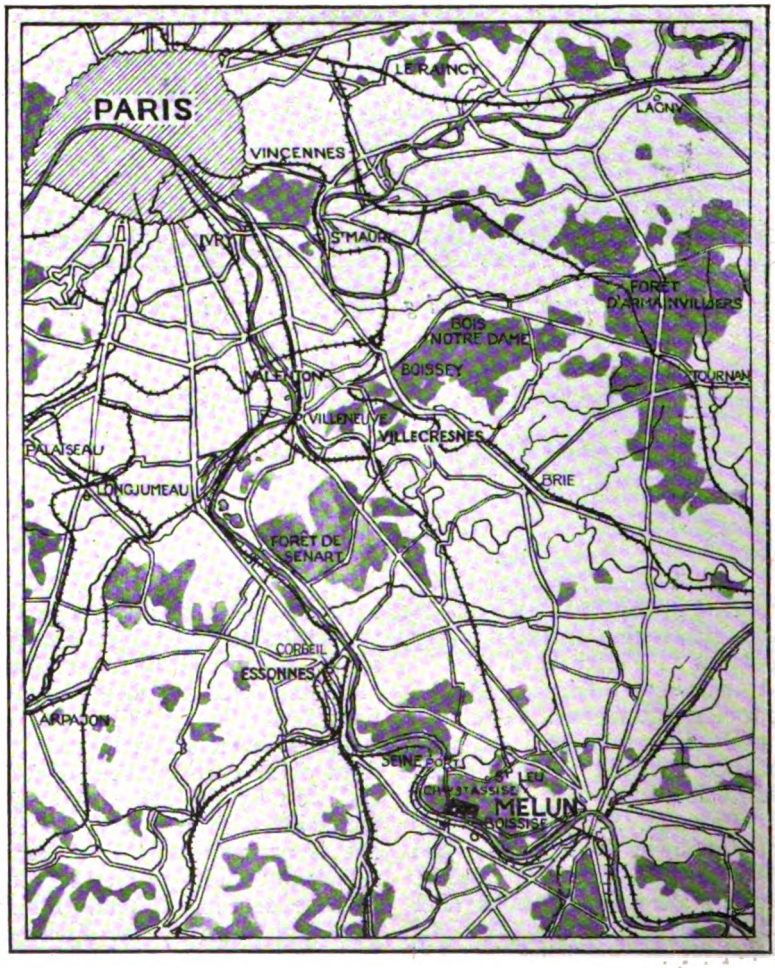


*Fig. 2. Map showing the location of the Transmitting Stations at Sainte Assise, and the sites of the Receiving Centres.*

The earth system consists of 240 square yards of copper plates and ten miles of buried copper wires.

The four alternators (Fig. 4) can be run independently, or they can be used in combination to increase the output. They

Two sources of power supply are available, one a power distribution network, and the other an emergency installation of three Diesel engines each of 1,800 H.P. The station can transmit either with one machine of 250 kW., or with two such machines coupled, or similarly

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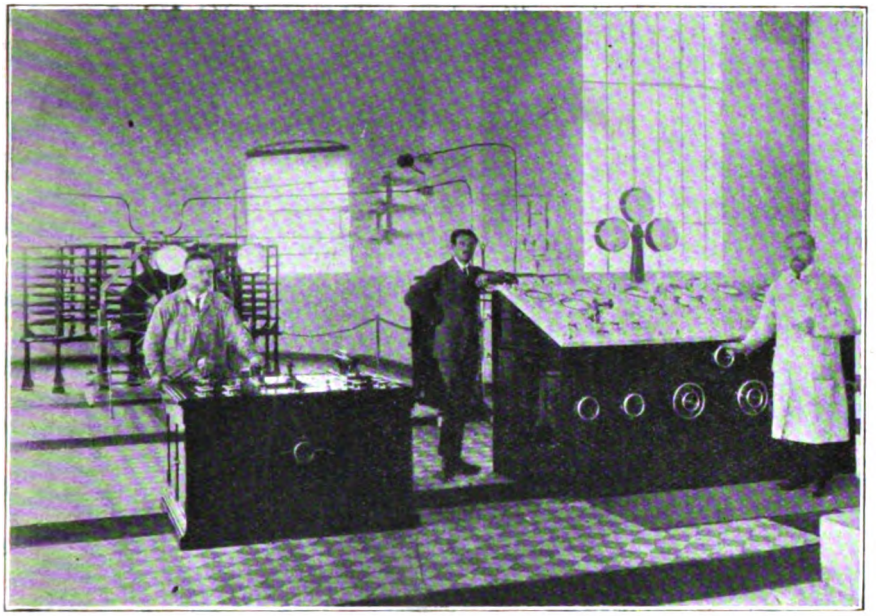

*Fig. 3. Room from which the transmitter is controlled.*

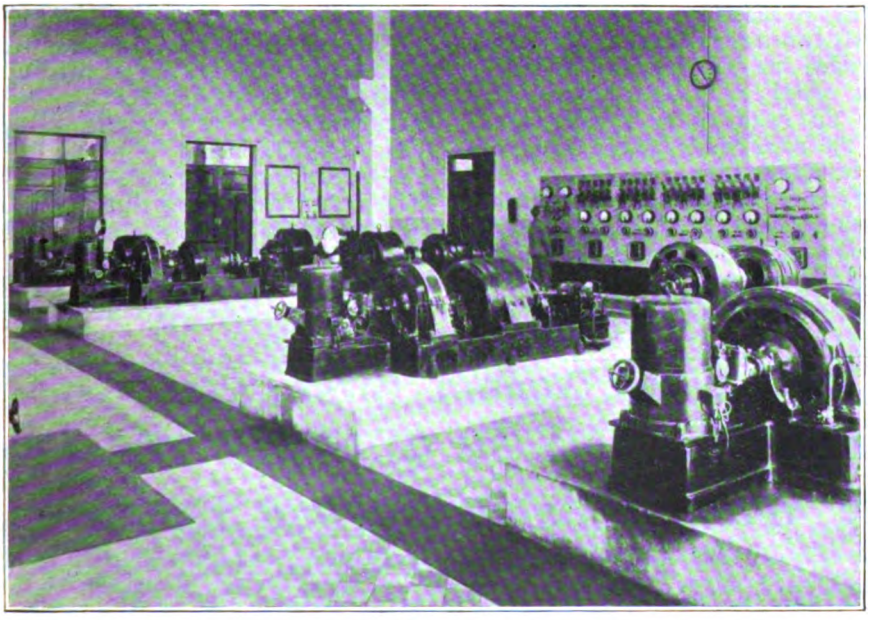

*Fig. 4. High Frequency Alternators.*

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*Fig. 5. A view of the operating tables in Paris.*

with one or two machines of 500 kW., or it may conduct two simultaneous transmissions.

The stations are all designed to handle traffic at a speed of at least 100 words a minute, so that with all six working transmitters at the same time, 36,000 words an hour may be transmitted.

Both the transmitting and receiving stations are controlled from the Bureau Central Radioélectrique, Rue Montmartre, Paris, in the centre of the business quarter. In addition this office is connected with the two principal Paris telegraph offices of the Bourse and Rue de Grevelle, by means of high speed Baudot and Hughes telegraphic apparatus. The recording apparatus for reception is all located on the same operating tables (Fig. 5), and the arrangements are very similar to those at Radio House, London.

The receiving stations are distinct from the transmitting centre, and these are located at Villecresnes, 22 kilometres S.S.E. of Paris, at Essonnes, 30 kilometres south of Paris, and Valenton, 18 kilometres S.S.E. of Paris. The location of these places may be seen from reference to Fig. 2.

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# A Suggestion for the Experimenter

By G. P. KENDALL, B.Sc.

DURING the war a telegraph instrument was evolved which had among other characteristics that of extraordinary sensitiveness to minute direct currents. It is the purpose of this contribution to suggest that the investigation of the properties of similar circuits would be a promising line for the experimenter who is interested in the problem of C.W. reception without valves, or at any rate, without local oscillations. The sensitiveness of the instrument referred to was achieved entirely by means of a com-

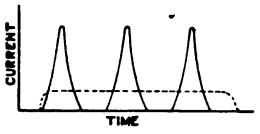



*Fig.* 1,

bination of filter and interrupter circuits, and not by the use of any type of relay or amplifier. As an instance of its efficiency this should suffice :—A certain signal officer was in the habit of demonstrating its powers by an experiment in which the sending battery consisted of an orange into which were struck an army knife and fork, while the "line" was a chain of twenty men holding hands. It can be imagined that the current obtained from such a combination of feeble cell and high resistance line would be very small, yet on being applied to the terminals of the set it produced good strong signals in the receiver, which was a rather insensitive pattern of only

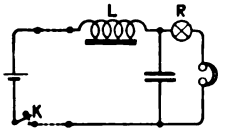
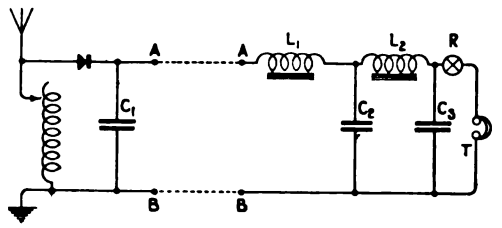



*Fig.* 2.

20 ohms resistance. It was said, though the writer never had the opportunity to put the statement to a rigid test, that signals could be received through a line resistance of a megohm with only a single dry cell at the sending end.

The principle upon which the instrument worked was the conversion of the very small continuous current into an intermittent current consisting of brief pulses of much greater volume, separated by comparatively long intervals during which the line current was being stored up in condensers. The pulses, of course, followed each other at a suitable note frequency. The relation of line current to receiver current will be more clearly seen from Fig. 1, where the two are represented by a dotted line and a full line respectively.

How it was done will be understood from the simplified circuit of Fig. 2, in which is an iron core choke L, a 1 mfd. condenser, and an interrupter R running at, say, 500 cycles per second. The mode of operation is as follows :—Suppose the key K to be closed at a moment when the interrupter is "making." The line current will pass through the choke, the interrupter and the receivers. The next moment the interrupter contacts open and the current can no longer flow through the




(L) *Fig.* 3. (R)

telephones, but is forced by the choke to go on flowing somewhere, and therefore charges the condenser. The line current is thus more or less maintained until the interrupter contacts close again, when the flow through the telephones is resumed, greatly augmented by the discharge of the condenser. Repetition of the cycle then occurs, and continues so long as K is depressed, producing a note in the telephones.

The suggested use of this type of circuit is the detection of the minute d.c. which appears at the terminals AB of Fig. 3 (L) when receiving C.W. A circuit which would probably give good results when connected to the respective terminals of Fig. 3 (L) is given in Fig. 3 (R.) The success of circuits of this type depends largely



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upon suitable values for chokes and condensers, and it is here that a little experimenting is required. The following data is given as starting points :—

$C_1$ = 0·005 mfd.

T = 120 ohm Brown telephones (probably better than H.R.).

$C_2$ and $C_3$ = ¼ to 1 mfd. (try ¼ mfd. first, then larger values).

$L_1$ and $L_2$ = Say, ½ × 3 in. core and 1 oz. of No. 42 D.S.C. wire.

R = Interrupter, preferably one of the army double contact buzzers, which can be obtained quite cheaply from one of the various ex-government telegraph sets now on the market. These buzzers (known as the D Mark III Type) can be easily arranged to buzz on one contact only, leaving the other free for use as an interrupter. Of course, a motor-driven one can be used if available.

The crystal detector employed should be a Perikon, or, failing that, some other combination which does not need a potentiometer.

The above values are likely to require a good deal of modification, but as they stand will probably give considerably better results than the pre-war " tikker " circuit.

# Wireless Without an Aerial

## A NEW LINE OF EXPERIMENT FOR AMATEURS

By PERCY W. HARRIS.

THE aerial problem, which presents certain difficulties even to those who have their own ground on which to experiment, is particularly troublesome to the flat dweller. Possessors of multi-valve sets can of course utilise a frame or loop, and a certain amount of success is obtainable with wires slung across the room. But neither of these expedients gives results comparable with those given by an outside aerial.

American wireless literature has recently contained announcements of experiments by Major-General Squier and others whereby an outside aerial is dispensed with entirely, the electric light mains being utilised instead. The idea is certainly attractive, and already several firms are advertising attachments under fancy names for connecting ordinary wireless apparatus to the mains. Particularly with alternating current supply, it might be imagined that this connection would occasion a terrible howl in the 'phones, but such is not the case.

The current American wireless journals in particular contain several such advertisements. We have, for example, the " Super-Antenna" (price $2.80). " It is fool-proof and shock-proof and can be used effectually in place of overhead antenna. No power is used when operating with a Super-Antenna." " It operates on any electrical circuit from 32 to 120 volts D.C. or A.C." Similarly we have the " Marble Antenna," which " completely replaces all ordinary wire aerials and outside wiring. . . . . A beautiful ornament suitable for office or library," and so forth. Price 3 dollars.

The writer has no direct knowledge of the construction of these wonderful new instruments, but he can make a shrewd guess. In any case, he has succeeded in duplicating the results with the simplest possible apparatus, and the results of his experiments are hereby offered to other amateurs.

The first clue was obtained from the latest advertisement of aerial replacing devices. When one of the leading condenser companies added such a device to their list, it certainly seemed likely that a condenser formed part of the equipment. Having two or three excellent Navy-type 0·001 variable condensers, the writer wired them, two of them as in the accompanying diagram, connecting one to each wire of the mains, by means of an ordinary plug attachment, the other sides of the condensers being attached to a common wire taken to the aerial terminal of the set. The receiving apparatus was that described in recent issues (a four-valve set for short wavelengths), and the tuned anode circuit was set for 600 metres,

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as there is always "something doing" on this wave.

Without daring to put the phones on, the writer switched on the valves, expecting a terrible howl. There was neither howl nor signal. Various adjustments of the aerial tuning condenser in parallel were tried with no result. The condenser was then placed in series, and almost immediately North Foreland came in loud and clear on three valves. Tuning with the series condenser was extremely sharp, and a vernier would have been useful. Other channel stations, such as FFH (Havre) were also heard with the phones on the table.

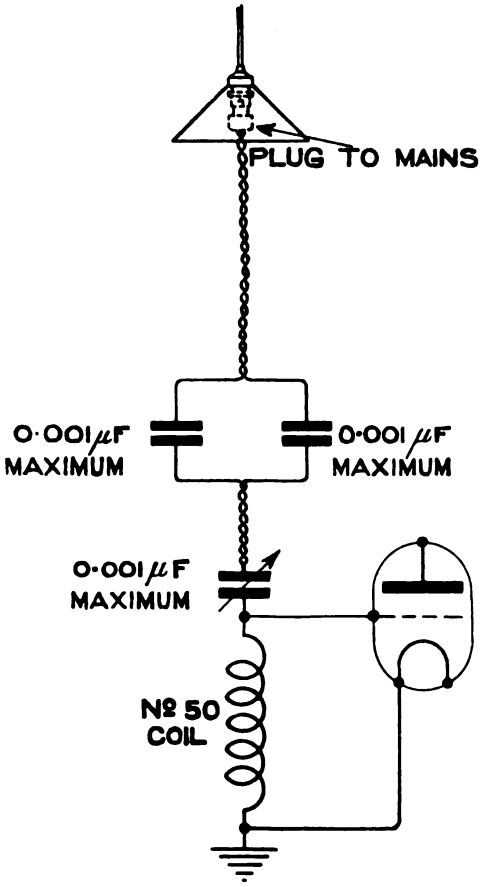
For the initial experiments the two condensers on the mains were both carefully set at maximum. Any alteration of the values was found to alter the tuning very considerably. When retuning was effected, the signals were practically the same strength with the condensers reduced to nearly minimum, and wide differences in the two values were tried without altering the general effect, other than the tuning.

As a guide to other experimenters, it may be said that to get ships signals it is necessary to use a condenser *in series* with a coil which, attached to an ordinary external aerial, would need a small condenser *in parallel*. A No. 50 plug-in coil needs 0·0005 approx. in series for tuning, and two 0·001 mfd. condensers on the mains to give North Foreland at about half its capacity.

Experiments were then tried on shorter waves, and Major Parker (2 ON) may be interested to hear that his tests with 2 KT and Luton on Monday evening, August 14th, were very useful. "The Lost Chord," "Vesti la Giubba," and other selections, as well as the familiar "Hullo, Hullo, Hullo!" were audible all over the house on four valves and the loud speaker, while three valves and the loud speaker were good enough for the occupants of the room. The coil and condenser already found satisfactory for 600 metres, were used, and tuning was effected alternately on the mains and the set, to see what difference was found. Again the tuning was found very critical, although wide differences in the mains condensers, when compensated in tuning, were found equally satisfactory. As an example, excellent results on 2 ON were obtained with the following adjustments :—

Mains condenser 1 .. 0·0001 mfds.
Mains condenser 2 .. 0·0005 mfds.
Series tuning condenser 0·00021 mfds.
Burndept shortwave coil No. 4.

Atmospherics were about the same strength as with the outside aerial, and switching off the light (or what would have been the light if there had been a lamp in the socket) reduced the strength of the signal to about a tenth of its previous value.




*Diagram, showing Circuit.*

A few experiments have been made on long waves, and Stavanger and Nauen successfully received, but on the night these experiments took place static was extremely bad on outside aerial and the mains equally. The first impression is that the efficiency is not so great on long waves. On short waves such as 600 metres and the concert band, this method seems much superior to any indoor aerial so far tried. There seems no noise whatever from the mains themselves.

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# Notes

### Imperial Patent Rights.

A conference was held at the Patent Office, London, to consider the practicability of instituting a system of granting patents which would be valid throughout the British Empire. The Chairman was the Comptroller-General of Patents, Designs and Trade Marks, Mr. W. Temple Franks, and representatives from all over the Empire, except Newfoundland, were present.

A report of the conference (obtainable from H.M.S.O., 1s. 1d., post free) has just been issued, in which it states that an agreement was reached, without calling witnesses, that a British Empire Patent, otherwise a patent which would be operative throughout the Empire, would be desirable provided it in no way affected the autonomy of the Dominions and India, or the rights and facilities which an inventor at present enjoys in these countries. With this object they decided on a scheme for the establishment of a central office for the reception and examination of applications for, and the grant of, patents. Until it should be possible to introduce the full scheme a provisional scheme was adopted. The conference was of opinion that whether or not the schemes suggested were found to be practicable, it was of the highest importance that both the procedure and practice in respect of the grant of patents should be uniform throughout the Empire.

### Demonstration at Broadstairs.

A demonstration and concert were conducted in the Pierremont Hall, Broadstairs, a few days ago. The apparatus used was constructed by Mr. P. F. Cotton, and the Brown loud speaker was lent by the makers.

The function, which was organised by the *Broadstairs and St. Peters' Echo*, was the outcome of experiments which have been proceeding for some time. Perhaps one of the most persistent amateurs in that district is Mr. A. H. Pound, who since 1909 has carried out research until, with the co-operation of Mr. Cotton and the influence and practical aid of the local newspaper mentioned above, a public demonstration was attempted and met with complete success.

The precaution was taken of warning the audience that owing to the close proximity of the North Foreland station, interruption might take place. As the North Foreland Station is only 2,000 yards from the Pierremont Hall, there was some interruption, but not so much as to disappoint the audience.

### Esperanto and International Wireless Transmissions.

Perhaps in the near future we shall hear more of Esperanto in connection with wireless transmissions. Dr. Pierre Corret, Editor, *La T.S.F. Moderne*, who is an enthusiastic supporter of this language, proposes to make transmissions from his station in Paris in Esperanto. An interest is also being taken in the subject by the American Radio Relay League, probably in view of the possibility of international amateur transmissions of the future.

### Agents for the Homcharger.

We are now able to state that the agents in this country for the apparatus to enable electric batteries to be charged from A.C. circuits, known as the Homcharger, are Messrs. Ashworth and Smith, Bridgewater House, 60, Whitworth Street, Manchester.

### South London Club's Exhibition.

Under the auspices of the South London Wireless and Scientific Club an exhibition is being held at St. John's Institute, Larcom St., Walworth, S.E.17. The Exhition opened on Thursday at 2 o'clock and closes on August 26th at 10 p.m. One of the special features of this exhibition is a wireless controlled airship in operation by the inventor Capt. de Villiers. Other attractions are a wireless controlled torpedo boat, broadcast receptions, numerous trade and amateur exhibits, and frame aerial transmission and reception. St. John's Institute is two minutes walk from Southwark Town Hall and the same distance from the Elephant and Castle. Admission to the exhibition costs One Shilling. Refreshments are obtainable on the premises.

### Radio in Northern Canada.

Broadcasting, both in the United States and Canada, has made life in the Porcupine Goldfields very different. Concerts, market reports, educational lectures, etc., are now received.

Vacuum tube sets are used, and one amateur especially has had exceptional reception from American amateurs over long distances, using very small power tubes.

The largest gold mine, the Hollinger, is equipped with an expensive tube set, and another large mine is installing one also.

A mining student of Queen's University, Kingston, Ontario, says that wireless telephony is greatly appreciated in these parts and all out-of-the-way places, but that disappointment was expressed when advertising began to creep in.

### Secretary of the Norwegian "R.A.K."

Mr. Kaye Eystein Weedon points out that he is not, himself, the Honorary Secretary of the N.R.A.K. (Norwegian Wireless Amateur Club) as stated in our note on "Conditions in Norway," in July 22nd issue.

### PCGG on August 17th.

Broadcasting of the *Daily Mail* concert from the Hague was suspended on August 17th on account of the funeral of Viscount Northcliffe taking place on that day.

### Senatore Marconi's tribute to Lord Northcliffe.

At the annual general meeting of Marconi's Wireless Telegraph Company, Limited, Senatore Marconi said: "It is with very deep regret that we learn of the death of Lord Northcliffe. No man in this country has done more for journalism and the dissemination of news. We feel we have lost a valued and respected friend, for Lord Northcliffe always followed and took the keenest interest in the development of wireless telegraphy and wireless telephony."

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**British Wireless Relay League (B.W.R.L.).**

Mr. Y. W. P. Evans, Hon. Secretary of the Manchester Wireless Society, has obtained permission from the Postmaster-General to form a British Wireless Relay League, which a great many amateurs possessing transmitting licences have been looking forward to. Mr. Evans will be pleased to hear from those interested with a view to forming such a League as early as possible. With a good organisation, and assuming that the forthcoming transmitting tests between the Manchester Wireless Society and the American Amateurs are a success, there is a possibility of the scheme providing a means of opening up a vast field for the experimenter. Letters should be addressed to Mr. Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester. Suitable agenda will be drawn up and distributed to those in favour of the League. Suggestions will be welcomed, and any assistance will be appreciated.

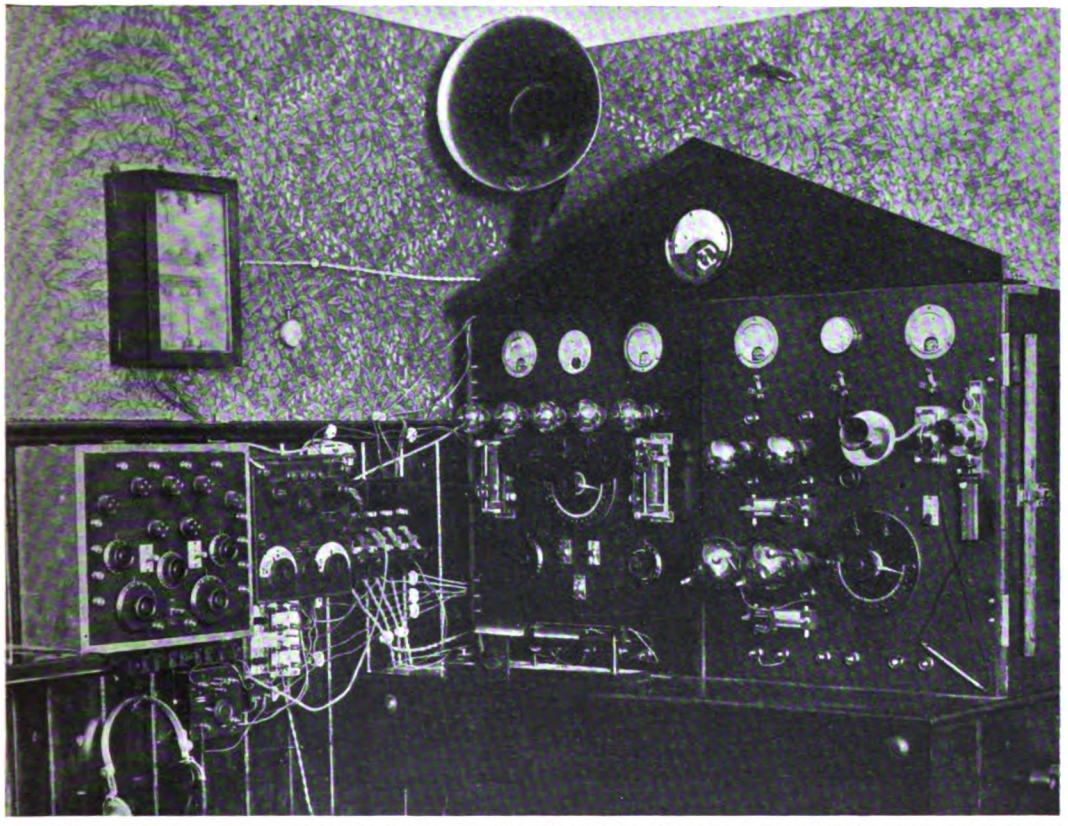
**Teletype in American Aeroplanes.**

An announcement is made by the United States Navy Department that an apparatus has been perfected for the use of airmen in communication with the ground. Signals corresponding to letters struck on a keyboard are automatically sent out by the wireless set and are received on a special type of instrument corresponding to a typewriter.

**German Demand.**

German inhabitants of Swakopmund, South-West Africa, have demanded the re-establishment of a wireless station.

## 2 FG. THE TRANSMITTER AND RECEIVER OF Mr. L. H. McMICHAEL.



The main panels represent to the left-hand side a five-valve receiving set, 2 high frequency, 1 detector and 2 low frequency, with the necessary meters and arrangements for using either coils behind the panel or external tuning coils. The loud speaker speaks for itself.

The right-hand side of the main board contains the transmitting set and the lower pair of valves are for rectifying 3,000 A.C. current, the upper pair of valves for transmitting, one a power valve and one a control.

Two microphones are available, as will be seen, for use with the change-over switch.

The whole set is mounted in an ex-Marconi ship's oak cabinet. The lower portion can just be seen, and it has two doors which open, and inside are housed the transformers, chokes, condensers, accumulator charging rectifier and the accumulators. To the left on the wall, under the distributing board, is a five-valve set, and to the right of that the T.F. three-valve set. A most efficient instrument. Change-over switch for transmitting and receiving is to the right of this again.

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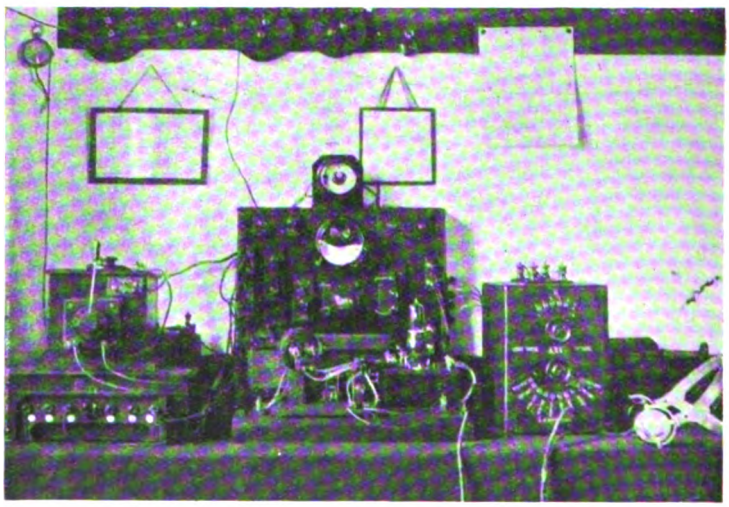
# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Since the last letter I wrote, an acknowledgement of which I received to-day, in answer to Mr. Stephenson, I have often been able to pick up the harmonics from **EAB** on 430 m. that he refers to. On comparison with the fundamental I find this much stronger than the harmonic, but not to the degree that one might expect after comparing the strength of harmonics from **GBL**.

With reference to this last station, the signals from **GBL** are readable on the 19th harmonic, just below 450 m., using two valves, one rectifier and one L.F. note magnifier.

I enclose a photograph of my station, which is entirely home-made, with the exception of valves, batteries, phones and instruments and such details as studs and terminals. In your paper I have noticed, in reply to correspondents, that you have been giving advice about engraving and filling ebonite.



In my set this was done by engraving by means of the usual hand-tool, and filling in by means of white water colour. This makes a very good finish, and the paint is not liable to fall out. Oil paint, of course, is better, and both methods are cheaper than filling with special wax.

Since the photograph was taken a condenser (0·0005 mfds.) has been fitted across the reaction. Behind the tuner in front is a change-over switch, changing from the tuner in front to the one on the right. This large tuner may be used for wavelengths of from about 5,000 to 30,000 m., and is tapped below 5,000 m., but not used on these ranges.

Tuning on short waves is done with basket coils, sometimes using those with spaced windings, or "Lokap" coils. I find the basket coils best for this work, however.

The best telephony received here is **FL**, which comes in fairly strong and clear, the weather report being very easily followed. Croydon is not bad, but **PCGG** and **2 MT** are of practically no use up here until H.F. amplification is added.

On long waves the longest range yet is **NPM** time signals, about 9,500 miles. Might I take this as good for such a combination of valves as I employ —1 rectifier and 1 L.F. note magnifier?

A. C. DRUMMOND.

# Book Review

THE SIGNAL SERVICE IN THE EUROPEAN WAR OF 1914 TO 1918 (FRANCE). By R. E. Priestley, M.C., B.A. (late Major, R.E.). Published by the Secretary, the Institution of Royal Engineers, and by the Signals Association. (Chatham: *W. & J. Mackay & Co., Ltd.*)

The aim in the preparation of this book has been to present a full yet concise history of the British Signal Service in France during the great war.

The work covers the evolution of signal policy, organisation and practice from the date that British troops first landed in France up to the cessation of hostilities.

The preparation of such a volume could only be the result of a vast amount of work on the part of the compiler, coupled with a keen observation exercised over a long period of practical experience of the lessons of the war as affecting the signal service.

It is obvious that one difficulty which must have been experienced was to sort out from an immense amount of available data, that which was suitable to be utilised in the preparation of such a history.

All those who were associated with the Signal Service during the war cannot fail to appreciate to the full the opportunity which this book affords of going over again the account of the activities of the Signal Service in all aspects of the campaign, this time being able to appreciate the reason for every fresh move in organisation or practice as it became necessary with the changing aspects of the Army's activities.

No attempt has been made in this volume to deal with the work of individual signal units, and the author rightly suggests that such a course would have been undesirable.

The book contains several illustrations of interest, whilst at the end a number of charts are given illustrating the distribution of signal units and organisation for communications at different stages of the war.

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# A New Publication.

Under the title of "Journal of Scientific Instruments," there has just appeared a preliminary number of a monthly publication produced by the Institute of Physics with the co-operation of the National Physical Laboratory.

The publication will deal with the principles, construction and use of scientific instruments of all kinds.

The new journal is introduced in a foreword to the first number by Professor Sir J. J. Thomson, President of the Institute of Physics. Referring to the purpose of the new journal, he states that it has long been recognised by many workers that a journal dealing with methods of measurement and the theory, construction and use of instruments would have a great value as an aid to research in all branches of science and industry. There is at present no publication in the English language which covers this ground. Descriptions of instruments and methods of measurement are given in journals devoted to particular branches of science; but in such publications results are of primary importance, and little space can be afforded to descriptions and detailed drawings of instruments. It frequently happens that instrumental methods are valuable for researches of quite a different character from that for which they were developed, and workers who may be interested in apparatus as distinct from results obtained may never see the publication in question, even if they know of its existence.

It is proposed that a journal on the lines suggested shall be produced by the Institute of Physics, which will ensure that the management shall be absolutely independent. It will be managed by a Finance Committee appointed by the Institute, on which the Department of Scientific and Industrial Research and the National Physical Laboratory, assisted by a Scientific Advisory Committee appointed by the Institute of Physics.

The expenses of the Journal will necessarily be considerable, as a high standard must be established and maintained, and it is doubtful whether receipts will cover expenditure, at any rate to begin with. Neither the Institnte of Physics nor the Department of Scientific and Industrial Research has funds available to meet a deficit. Steps are being taken to raise a guarantee fund for the purpose.

Before it can be finally decided to publish the journal, it will be necessary to have some indication as to its probable circulation, and prospective readers are asked to notify their intention to subscribe. It is proposed that the journal be issued monthly, and be similar in style to the preliminary number. The price will be 2s. 6d. (postage 2d. extra), or 30s. a year, post free.

It is estimated that with a circulation of about 1,000 there will be a deficit of some £2,000 per annum, while a circulation of about 3,000 will render the journal self-supporting.

# Book Received

CONSTRUCTION OF NEW TYPE TRANS-ATLANTIC RECEIVING SETS. By M. B. Sleeper. (New York: *The Norman W. Henley Publishing Compy.* Pp. 113. 7½″ × 5″.)

# Calendar of Current Events

**Saturday, August 26th.**

SOUTH LONDON WIRELESS AND SCIENTIFIC CLUB. Last day of Exhibition, opened on August 24th, at St. John's Institute, Larcom Street, Walworth, S.E. 17.

**Tuesday, August 29th.**

Transmission of Telephony at 8 p.m. on 400 metres, by **2 MT** Writtle, near Chelmsford.

**Wednesday, August 30th.**

SOUTH SHIELDS Y.M.C.A. WIRELESS SOCIETY. 7.30 *p.m.*—Fowler Street, General Meeting.

**Thursday, August 31th.**

RADIO EXPERIMENTAL ASSOCIATION, NOTTINGHAM AND DISTRICT. 7.30 *p.m.*—At Room 74, Mechanics Institute, Nottingham. Meeting.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION. At Belmont Road Schools, Chiswick, W. First meeting after vacation.

**Saturday, September 2nd.**

CROYDON WIRELESS AND PHYSICAL SOCIETY. Meeting.

**Monday, September 4th.**

ILKLEY AND DISTRICT WIRELESS SOCIETY. 8 *p.m.*—At Regent Café, Cowpasture Road, Ilkley, Morse practice.

**Tuesday, September 5th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2 MT** Writtle, near Chelmsford.

**Friday, September 8th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY. 8 *p.m.*—Lecture on "Automatic Telephony," by Mr. H. Mortimer.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY. 8 *p.m.*—Erith Technical Institute. General Meeting and enrolment of members.

# The Broadcasting Company

The following statement has been issued by the Committee of Manufacturers who are at present engaged in creating the Broadcasting Company:—

"The Committee have observed that a number of unauthoritative statements have been made with regard to broadcasting, and desire it to be known that until the British Broadcasting Company is registered, and the Board of that Company has been appointed, no authoritative statement, in so far as the Broadcasting Company is concerned, can be made with regard to the future of broadcasting.

"The Memorandum and Articles of Association of the Company are in course of preparation, and as soon as these are approved, the Company will be registered, and the Board appointed. Thereafter a full statement will be issued."

(Signed) GEO. PELLS,
*Secretary (pro tem.)*
The British Broadcasting Company.
*August 17th*, 1922.
Marconi House, W.C.2.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, New Brighton, Wallasey.

On July 27th the first General Meeting of the Society was held. The Hon. Auditor read the balance sheet, which showed the Society to be in a most satisfactory financial condition.

It was arranged to print the syllabus for the coming winter session, and also to publish a report on the Society's work in the form of an annual magazine.

The meeting night, until further notice, will be every alternate Thursday, the next meeting being on August 24th.

Members will be advised by post when field meetings are arranged. Friends of the members wishing to attend the meetings will be advised of the dates on notifying the Hon. Secretary.

The rules of the Society do not permit of visitors attending more than two evenings or field meetings during any one session.

All communications should be addressed to the Hon. Secretary.

## Blackpool and Fylde and Lytham St. Annes Wireless Society.*

Hon. Secretary, Mr. C. Sheffield Doeg, "The Poplars," 6, Seventh Avenue, South Shore, Blackpool.

This Society is now well established. Membership is still going up steadily, and an Assistant Hon. Secretary was appointed a short time ago to help to cope with the business side of the Society's affairs.

In June last a branch was opened in the South-West Area of the Fylde District for the benefit of members who otherwise would have to cover upwards of ten miles to reach the Blackpool headquarters.

Although Blackpool is comparatively of humble proportions, the Society finds support from a district quite as extensive as either Manchester or Liverpool.

This departure when made was very much overdue; 25 members were automatically transferred from the Blackpool headquarters, and this number has since been doubled by new members joining. Both a transmitting and receiving licence has been applied for.

A transmitting licence for the Blackpool headquarters is daily expected, and when it arrives a broadcasting service is to be inaugurated for the benefit of its members and others, and also for an interchange of messages with the Lytham St. Annes Station.

On July 13th, Mr. B. D. Taylor, the Hon. Librarian, submitted for inspection a home-made loud speaker, an adaptation of a motor car petrol-filler.

On July 20th, Mr. Taylor demonstrated the capabilities of a home-made but very well-constructed and compact one-valve set.

On August 3rd Messrs. J. V. Potter and D. B. Taylor, after considerable trouble and patience, evolved an ingenious three-valve amplifier which should equal if not excel the well-known four-valve variety, as the clarity and intensity of the signals heard by means of this instrument amply justify the claims made on its behalf.

The Executive Committee, whilst fully realising that mere numerical strength is not everything, encourage the bashful but enthusiastic amateurs, knowing that the making of sets is half the battle, and fosters the initiative of members.

One of the many problems which the Society is tackling is the evolving of a circuit, the use of which will prevent badly manipulated amateur stations causing interference, which at the present time is causing so much trouble and annoyance.

## Leamington, Warwick and District Radio Society.

Hon. Secretary, Mr. F. A. Sleath, 31, Archery Road, Leamington Spa.

The first General Meeting of the above Society was held at the headquarters, on Thursday, August 3rd. In the absence of the President, Captain Smith-Clarke, M.I.A.E., M.S.A.E., the Vice-President, Mr. G. H. Champ, carried out the duties of Chairman, and opened the meeting with a brief résumé of the Society's position and future arrangements. For the time being, lectures will be devoted to constructional items and buzzer practice.

Mr. Marriott was then called upon to give a short address, and he compared the crystal and valve receivers, dwelling on the limitations of the former. Mr. Marriott next described the five-valve receiver kindly lent for the occasion by Messrs. Champ and Kay. The set was then switched on and almost immediately station **2 KO** (Mr. C. Baynton, Moseley) was heard transmitting a gramophone selection.

An attempt was next made to receive the *Daily Mail* concert, but it was only possible to hear a tremendous carrier wave, and when this was tuned out, the speech was barely audible in the phones. More selections were received from **2 KO**, and with the aid of two loud speakers, the music was heard in the furthermost corners of the room.

The meeting terminated at 9.30 p.m. with a hearty vote of thanks to the Committee for their arrangements, to Messrs. Champ and Kay for the loan of apparatus, and to Mr. Marriott for his address.

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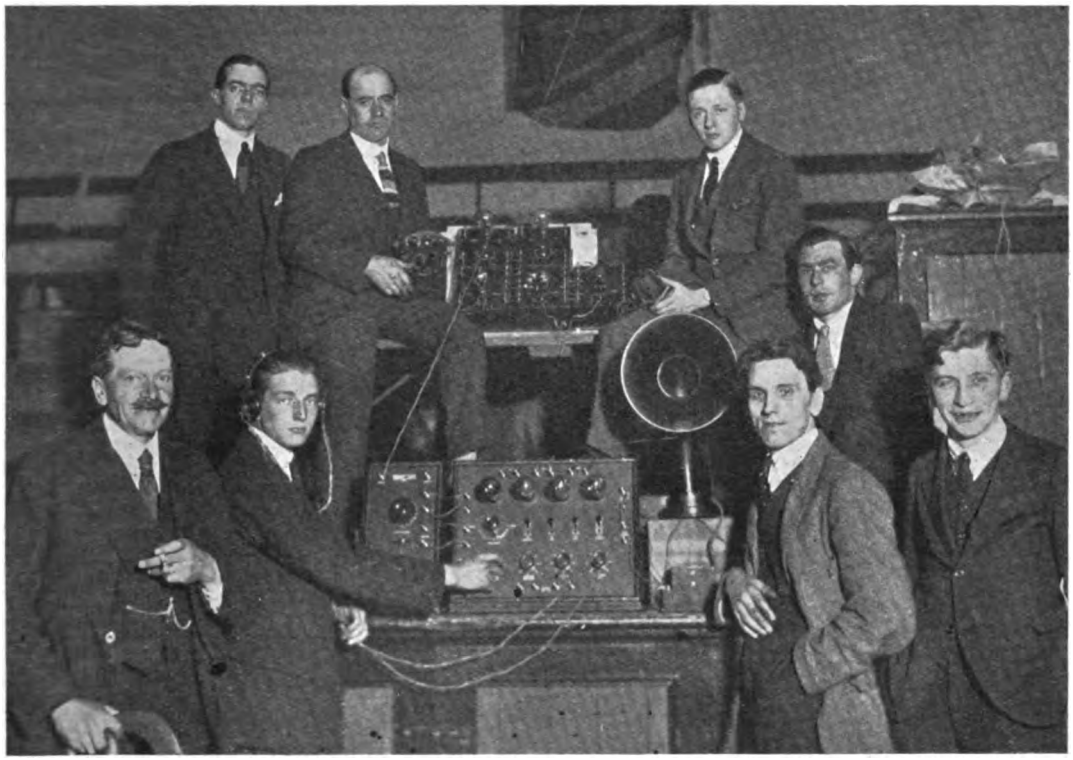
**Manchester Demonstrators.**

A group of the demonstrators at the first of a series of popular lectures the Manchester Wireless Society are giving, in order to give the public a better understanding of the instruments used, especially in broadcasting. In the centre of the back row is Mr. Y. W. P. Evans, the Hon. Secretary and one of the pioneers of wireless, who gave a most interesting and instructive lecture, assisted by Messrs. Lamb, Gregory, Barraclough, E. G. Davies and Hall, who are also shown in the group.



**The Durham City and District Wireless Club.**

Hon. Secretary, Mr. Geo. Barnard, 3, Sowerby Street, Sacriston, Durham.

The third meeting of the above club was held in the "Rose and Crown" on Friday, August 4th. Considering the fact that a large number of the members were on holiday, the attendance was quite large. Several new members were enrolled.

The meeting was a great success. The chair was once again taken by Mr. F. Sargent, F.R.A.S., of the Observatory, Durham, in his usual characteristic fashion. After the minutes were read and passed, a lecture given by Mr. G. Barnard on "The Electro-magnetic Theory and its Application to Wireless Telegraphy," proved very interesting to the members. He commenced at the very beginning so that no one would be left behind. At the termination of the lecture a hearty round of applause was given, after which the Hon. Secretary made some important announcements, among which were the following:—

The headquarters are definitely fixed at the Y.M.C.A., Claypath, Durham, where a receiving station will be very shortly installed.

Affiliation with the Wireless Society of London will probably be completed very shortly.

A question box is to be fixed in the clubroom for the benefit of members who prefer not to speak at the meetings. A full list of officers is being prepared. Membership cards are now ready.

After the announcements, a lively discussion took place, during which it was decided to have a half hour's Morse buzzer practice at each meeting. Mr. Kelly (Hon. Treasurer) presented the club with a very fine loud sounding buzzer of the open type. His kind action was greeted with hearty applause. Mr. Nurthen, who is on the Committee, has undertaken to take charge of the buzzer class, he having had considerable transmitting experience. The Chairman made some very interesting remarks. He was glad the lecturer had mentioned Dr. Gilbert as one of the founders of electro-magnetism, and pointed out the wonderful achievements of Britishers in the science of wireless.

A further meeting took place in the Y.M.C.A., Claypath, on Friday, August 18th, at 7 p.m., when a lecture was given by Mr. G. Barnard on "The Production of High Frequency Oscillations."

The Hon. Secretary invites all who are interested to attend the next meeting, or send names and addresses of any person, either sex, desirous of becoming members, so that he may submit them as candidates for election to the club.

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### The Liverpool Wireless Society.

Hon. Secretary, Mr. C. L. Lyons, 76, Oldhall Street, Liverpool.

A very successful and interesting meeting of the above Society was held at The Royal Institution, Colquitt Street, Liverpool, on Thursday last, the 10th instant.

The early proceedings were devoted to the answering of the question box which had been passed round, and Mr. Hyde explained away the difficulties of the questioners in his usual inimitable manner, illustrating his answers by very clear blackboard diagrams.

An advisory committee was then elected, consisting of Messrs. S. Lowey (whose four-valve station was described in the August 12th issue of *The Wireless World and Radio Review*), C. J. Williams, W. A. Robinson, Hyde, Forshaw, Henderson, Balmer and Coulton.

A vote of thanks was passed in favour of Mr. J. M. Wilkie, in recognition of his very able work on behalf of the Society when occupying the position of Hon. Secretary, which position he has unfortunately found it necessary to resign, and a new Secretary (see above) was elected. All members and interested readers are requested to note carefully the name and address of the new Secretary.

The evening was concluded by Mr. A. W. Robinson bringing into operation a "Burndept" three-valve receiving set (one H.F., one rectifier, one L.F.) very kindly lent to the Society for the evening by Messrs. Burndept's Manchester agent, Mr. Barraclough. Very successful results were received of both telegraphy and telephony, which were perfectly audible to all present, and which, in view of the fact that the instruments were operated in conjunction with an indoor aerial of but moderate dimensions, reflected great credit upon both the operator and the manufacturers of the set.

Another meeting was held at the Royal Institution, Colquitt Street, Liverpool, 7.30 p.m., Thursday, August 24th. All amateurs in the district not already members of the Society are cordially invited to join, and are assured of a continuance of entertaining and instructive meetings.

### Ilkley and District Wireless Society.

Hon. Secretary, Mr. E. Stanley Dobson, "Lorne House," Richmond Place, Ilkley.

The third meeting of the above Society was held at the Regent Café, Cowpasture Road, Ilkley, on August 10th.

In the absence of the President, Mr. F. Law occupied the chair. It was decided to arrange a programme of lectures and demonstrations for the coming winter session, and all members are asked to co-operate in this and also in procuring permanent headquarters, which are the most important requirement of the Society.

In order to enable those members who wish to listen in to the Hague concerts, it has been necessary to transfer the monthly meetings to the second Monday in each month, and the Morse practice classes, which are now in full swing, will be held on the intermediate Mondays.

The membership is still steadily increasing and new members are welcomed at any of the meetings.

Ladies who are interested in this subject are particularly invited to join. Particulars of membership may be had on application to the Secretary, who will also be pleased to receive offers from any gentlemen willing to give a lecture or demonstration, or to read a paper before the Society on any branch of the subject, either technical or practical.

### Fulham and Chelsea Amateur Radio and Social Society.

Hon. Secretary, Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W.6.

An informal meeting took place on Tuesday, August 1st, at 8.30 p.m., at the Stanley Ward Conservative Club, 428, King's Road, Chelsea. Mr. Oliver, the Chairman, explained the reasons of the meeting. Discussion was then invited as to the advisability of forming a local wireless society, and finally the following proposition was proposed by Mr. Scutt and seconded by Mr. Paterson: "That this meeting take the necessary steps to form an Amateur Wireless Society in Fulham and Chelsea." This was carried unanimously. On the proposition of Mr. Cox and seconded by Mr. Wood, Mr. Oliver was voted to the chair, and agreed to act for the time being. Mr. Glockler was voted to the vice-chair. Mr. Wood was elected Secretary, all the propositions being carried unanimously. A committee of management was then formed of the following gentlemen: Messrs. Scutt, Flood, Fildis, Martin, Paterson and Roberts, this committee being elected unanimously. A discussion took place on a suggested title, and that above was agreed upon.

It was then agreed that the next general meeting be called after the committee had sat to consider the necessary rules and details. A vote of thanks was proposed by Messrs. Gray and Gauntlet to the Stanley Ward Conservative Club for lending their room. Messrs. Martin and Roberts proposed a vote of thanks to the chairman, both of which were duly carried, the meeting being closed with expressions of appreciation on the forming of a local wireless society.

Ladies included, there was an attendance of 70.

### West Hartlepool Y.M.C.A. Radio and Experimental Society.

Hon. Secretary, Mr. S. Tillotson, 34, Tristram Avenue, West Hartlepool.

A Society has been formed with the above title, and though but a fortnight old the membership is 36. A grant from the Board of Management has enabled the Committee to purchase components with which to build a three-valve set, the erecting to be done by the members under the direction of the technical advisers, Messrs. C. Kenyon and Wm. Garrett. In the meantime these gentlemen have kindly loaned their own apparatus for the use of the club, and a successful lecture and demonstration was held on July 21st. Classes are held every Tuesday at 7.30 p.m., and instruction is given in the elements of electricity and Morse reading.

The club has erected an aerial, etc., which is open to members for individual use at any time. Application for membership is to be made to the General Secretary or the Hon. Secretary of the Society. The age limit is 15 years.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"H.A." (S.E.10)** *has a two-valve receiving set comprising one detector oscillator valve and one low frequency magnifier, with which he successfully receives* **2LO, 2MT** *and* **2FQ,** *and is desirous of either amending his circuit or adding additional amplifiers in order that he may be able to receive* **PCGG.**

Your circuit is quite in order, excepting that it is not necessary to connect a variable condenser across the primary of the intervalve transformer, and this condenser can be made good use of by connecting it across the ends of the reaction coil marked "S" in your circuit diagram. A small fixed condenser should be connected across the I.P and O.P., having a value between 0·001 and 0·002 mfds., and may consist of 15 plates interleaved with mica 0·002" in thickness, and having an overlap of 1" by ½". Seven will project at one end of the condenser and eight at the other. The tuning range of the coils would seem to be sufficient when connected to your two-wire aerial to tune to 1,070 metres, the wavelength of **PCGG.** The addition of a high frequency amplifying valve and another note magnifier would assure you of good reception from this station, particularly as we now understand that its power has been increased. A suitable circuit is given in Fig. 1. The rectifier valve should be of the "Q" type, or one specially recommended to function as an efficient detector.

**"M.B." (Plumstead)** *has a four-valve receiver, including one H.F. amplifier, which gives quite good results with a transformer designed to amplify on wavelengths between* 600 *and* 1,200, *but is unable to get good amplification between* 300 *and* 800 *metres.*

One probable cause of the trouble is, as you suggest, that as the set tunes up to a wavelength of 2,000 metres it does not function efficiently on such a low wavelength as 3,000 metres. Two special aerial coils should be made for tuning at this wavelength. You do not give dimensions of the short wave intervalve H.F. transformer you use, but we would suggest that you construct one having 180 turns for primary and secondary, wound on a 1" ebonite former, and separated from one another by a single layer of empire cloth. The windings should be in the same direction, and the finishing ends taken to grid and plate. This should be bridged with a low capacity variable condenser. For short wave work you may find it helpful to bridge the reaction coil with a low value variable condenser, and also the aerial tuning condenser must be connected in series with the aerial inductance for efficient short wave reception.

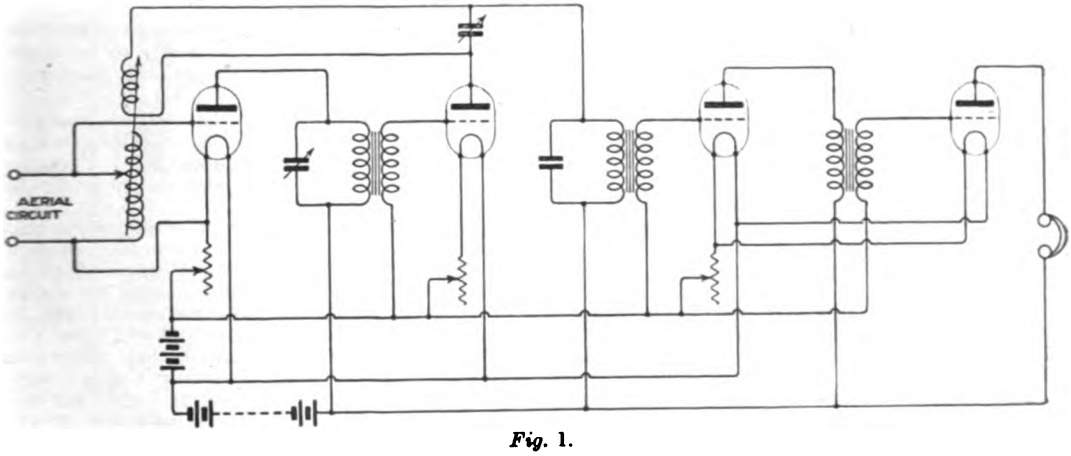


*Fig.* 1.

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**"C.H.C.G." (Otford)** *encloses a sketch of a three-valve amplifier and asks* (1) *For a method of using one, two or three valves at will.* (2) *Which is better, to tune the anode winding or the grid winding of the above arrangement with variable condensers.* (3) *If three or four lengths of 1" gaspipe would make a satisfactory earth.* (4) *If permission is required to use more than one valve.*

(1) The second method is quite O.K. The first method is also O.K. if arrangements are made to break the grid coil of the particular valve to which S is plugged at any time. (2) There is little difference, but the anode is somewhat preferable. (3) O.K. if the pipes go well down into damp earth. (4) If the addition of further valves is not covered by your original application, you should obtain sanction from the P.M.G.

**"EUREKA" (Durham)** *asks* (1) *If a circuit sketched is suitable for general purposes.* (2) *If circuit in No. 1 can be altered as in sketch No. 2.* (3) *If material enclosed is suitable for panels, etc., instead of ebonite.*

(1) All right, except that the condenser shown across the reaction coil would be better across the telephone transformer. (2) Yes, with similar comment to the above. (3) Yes, unless it is to be used under very damp conditions, when the surface leakage will probably be more serious.

**"IGNORAMUS" (Probus)** *asks* (1) *If the P.M.G. limits the length of aerial for amateurs.* (2) *If so, what is the length.* (3) *Will the efficiency of an aerial of given length be altered by another method of suspension.* (4) *The advantages of a basket coil over a solenoid.*

(1) and (2) Yes. The length from the lead-in insulator to the far end, measured along the wire, must not exceed 100'. As many wires may be used as desired. (3) A single line is best. Divided up into shorter lengths is undesirable. (4) It is somewhat more portable; also losses in the coils are somewhat smaller owing to the shape of the coil, but this increased efficiency is not great enough to be of much importance.

**"J.D." (S.E.18)** *asks* (1) *If a crystal receiver and valve magnifier give louder signals than a single valve with reactance.* (2) *Why his set will not work without a grid leak and condenser.* (3) *Wiring data for A.T.I.*

(1) Yes, as reactance is also used in this crystal and valve set. (2) The set worked quite well as originally given. Possibly you have got the wrong value for H.T. or unsuitable potential on the grid. Try reversing the reaction coil. (3) The set will be unsatisfactory without a variable condenser in the closed circuit. For the A.T.I. use 100 turns with a slider, and for the closed circuit 4" × 2½" of No. 26.

**"CONWAY" (London)** *asks re the American short wave tuner in June 3rd issue* (1) *If he will be infringing patents by making up some of these sets for friends.* (2) *Whether the condensers need be fixed or variable.*

(1) Seeing that his circuit uses magnetic reaction you will be infringing patents if you sell sets of this type. We cannot undertake to give complete advice relating to patents. (2) Neither of the condensers need be variable, but somewhat better results would be obtained if the grid condenser was variable.

**"N.P." (Whitstable)** *asks re the pocket set on page 747, March 4th issue* (1) *If it is a mistake to have the A.T.I. of No. 36 and the reactance of No. 26.* (2) *If the telephones are shown in the right position in the diagram.* (3) *If the positive terminal on the telephone goes to the positive of H.T. battery, and whether a long or short dash is used for the positive of batteries in diagrams.* (4) *A suitable capacity for the aerial condenser.*

(1) For general purposes, yes; but for a "stunt" receiver of this type the windings given may be necessary to get the required wave range, even at the cost of loss of efficiency. (2) Yes, but they may alternately be on the other side of the H.T. battery. (3) In the circuit shown, to the positive of H.T. A long thin stroke represents the positive of a cell. (4) 0·0005 mfds. maximum, minimum as small as possible.

**"K.R." (Bradford).**—There does not appear to be much to choose between the two aerials suggested. The aerial between the houses is probably slightly the better. The amplifier suggested would be of no use in conjunction with your set, but you might add any one of the various L.F. amplifiers on the market or described in back issues. There will probably be very little telephony within range of a two-valve set in Bradford until the broadcast service is inaugurated.

**"J.H." (Southsea).**—It is useless to try and bring your wavelength up much by just adding a loading coil to the aerial, although you might get up to 1,100 metres in this way with your present coils. To get ranges above this we should recommend using a set of slab coils, connected up as in your diagram, but cylindrical coils should not be used inside each other as shown. (2) 0·0005 mfds. is sufficient up to 3,000 metres. (3) Up to 1,100 metres your windings might be as follows—A.T.I. 5" × 4" of No. 24, closed circuit and reaction coil as you suggest.

**"G.C.C." (Gateshead)** *asks for advice on a two-valve set which behaves in an unsatisfactory way.*

We can see no real cause for behaviour in this way. A condenser across the telephones would improve the set, also we should omit the permanent connections between the switch arm and P.5. We think it likely that the transformer winding has a break, or disconnection in it. Try out all connections thoroughly. As a rule it is inadvisable to use windings given for pocket sets in general purpose sets, as such windings have generally to be made quite inefficient in order to get the necessary portability.

**"O.T." (Bridlington)** *sends sketches and asks* (1) *If he can improve his aerial.* (2) *Why his set starts oscillating when he gets tuned-in for Croydon, etc.* (3) *If we can give a wiring diagram for his set.*

(1) Yes. Raise the aerial further above the roof. (2) This is apparently due to too much reaction. If by tuning-in you include the adjustment of the reaction coil, behaviour is quite normal as signals improve with additional reaction until the set begins to oscillate. (3) We cannot say how your apparatus is connected internally, and therefore cannot give wiring diagram, and as the set gives spark stations and telephony, except for the howling trouble, there is probably very little the matter with the connections as you at present have them.

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**"R.R." (Paris)** *asks for a design of an efficient receiver suitable for reception on wavelengths from* 180 *to* 30,000.

The use of resistance capacity coupling for short wavelengths is not efficient, although small variations of the condensers in the grid circuits according to the wavelengths on which it is desired to receive will improve the results. Your process of calculating the value of this condenser as being directly proportional to the wavelength which it is desired to receive is quite incorrect. The chief consideration is the high impedance of this condenser on short wavelengths. We would recommend you to adopt three to five valves, according to the degree of amplification desired. The circuit shown (Figs. 2 & 3) embodies two H.F. valves, one detector, and two L.F., and can be thoroughly recommended for general use, but if you so desire you can omit one H.F. and one L.F. valve. The type of H.F. transformer you mention can be thoroughly recommended, and it might be mentioned that the efficiency of many H.F. transformers is rather doubtful, owing to the system of winding adopted. We do not see why you should not construct such transformers yourself, winding them on 1" ebonite rod, with single layer primary and secondary, insulated from one another with a single layer of empire cloth, the finishing ends being taken to grid and plate, and both windings being in the same direction. Wind with No. 40 S.S.C., and for wavelengths up to 300 metres use 180 turns for each winding; for 600 metres, 600 turns; for 1,000 metres, 1,300 turns; for 1,500 metres use 800 turns, and this time on a 2" ebonite rod. Beyond this wavelength resistance capacity coupling with fixed condensers is quite satisfactory. "V24" or French "R" valves may be used for amplifying, whilst a "Q" should be used for detecting. The H.F. detector and L.F. valves must be controlled with separate filament resistances, and it is an advantage to provide potentiometers for controlling the grid potential of the H.F. and rectifier valves. Separate tappings might also be arranged for the various valves to

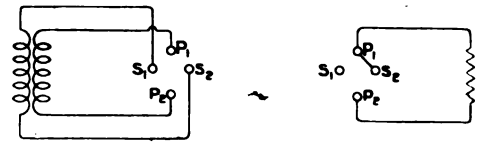


*Fig.* 3.

give them just the correct anode voltage required. If you adopt four-pin sockets for interchanging the H.F. transformers, the resistance capacity unit may also be built up to plug in for use on wavelengths above those provided by the transformers. The construction of the set described embodies no special difficulties, but we shall be pleased to advise you further should you have trouble during its construction.

**"F.A.W." (Brixton).**—(1) The inductance of the coil is about 7,000 mhys., which should tune to 2,500 metres—or more with a parallel condenser. (2) To get best value for reaction for different conditions of wavelength and aerial resistance. (3) This can be done and might give some results, but initial L.F. amplification would be better.

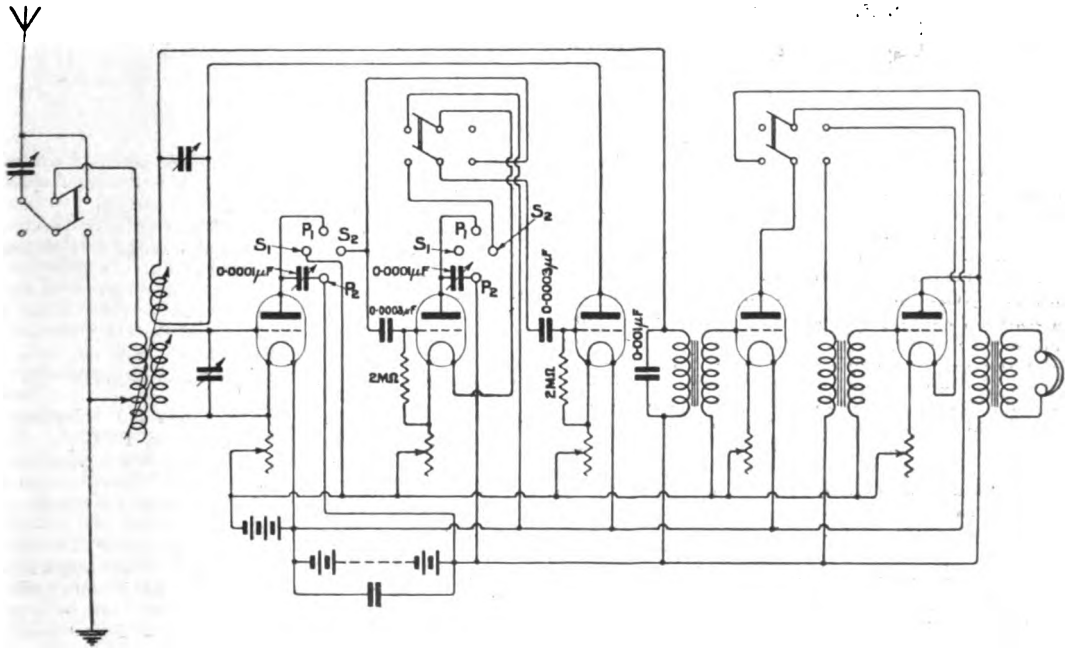


*Fig.* 2.



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**"C.N.G." (Pelton)** *asks how it is that he can only receive 600 metre signals on his single valve set.*

Your circuit diagram would indicate that your set is in order. We would suggest that you arrange a variable condenser across the ends of the reaction coil. Are you receiving continuous wave signals, and does your set oscillate? If not, the reason why you only receive 600 metre signals is that your set will only pick up damped wave signals, the majority of which are transmitted on this wavelength. Your aerial, although inside the roof, is of good length, and should give quite satisfactory results. We hardly recommend the addition of one H.F. valve as a first step in obtaining increased signal strength. A low frequency amplifier would give much greater magnification.

**"W.C.B.-G." (Bradford)** *asks for a diagram of a five-valve receiver, together with details as to size of inductances, number of turns, etc.*

See Fig. 4. Sizes of inductances and condensers according to wavelengths required.

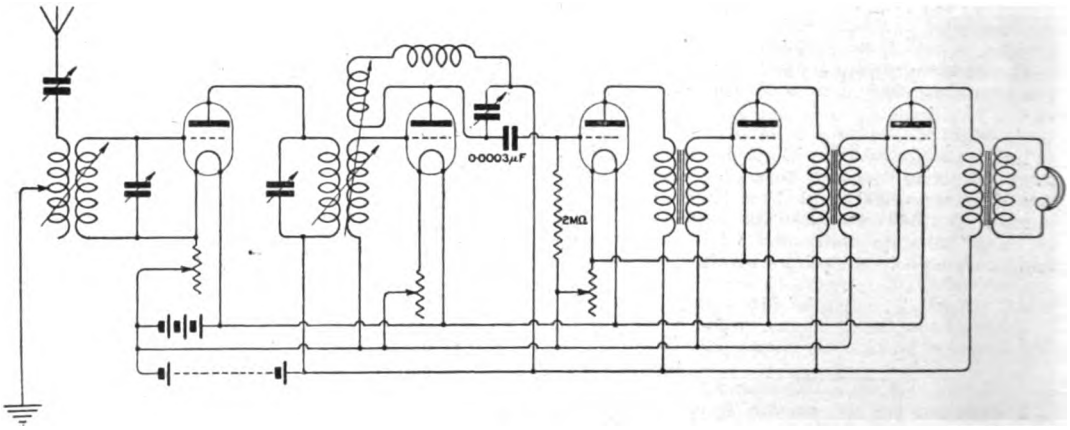


*Fig.* 4.

**"R.M." (Coventry)** *is constructing a two-valve receiving set. He has a number of components, and asks for advice on the selection and details of other parts required.*

Construct your own loose coupler or aerial and reaction circuits. The windings depend upon the wavelengths on which you require to receive, and for a start construct an aerial on your inductances having 4″ of winding of No. 26 D.C.C. on a 5″ former, and the reaction coil sliding inside this consisting of 2″ of winding of No. 30 D.C.C. on a 4″ former, arranging tappings at increasing intervals on both aerial and reaction coils. For short wave telephony reception construct two coils as shown on page 328, June 10th issue. The variable condenser should be of the air dielectric type, and have a maximum value between 0·0005 and 0·0015 mfds. The grid leak should have a resistance of about 2 megohms. "R.4B" valve would be found to give very satisfactory results. The panel for mounting the two valves might measure about 7″ × 4½″. You would obtain a good deal of useful information by reading the arti les published in alternate issues on "Experimental Station Design," and in particular the one on the construction of a single valve panel, appearing on p. 454 of the July 8th issue. This article really answers all your questions.

**"A.B T." (Wolverhampton)** *asks for details and diagram for the construction of a telephone transformer for use with his crystal set. His telephones have a resistance of* 100 *ohms.*

We do not recommend you to construct a step-down transformer for use with your crystal receiver. You would be well advised to rewind your telephones to a higher resistance. This would probably be less expensive, and without doubt more efficient, and very little instruction on the method of doing it is needed. Use No. 49 S.S.C. for the purpose. If you are desirous of making a transformer, however, turn to page 343 of the June 17th issue. You will find there dimensional drawings of core and end plates of the transformer. Wind the primary with No. 47 S.S.C. up to a diameter of ½″, over which wind a secondary of four layers of No. 32 S.S.C. Insulate carefully between primary and secondary.

**"F.B." (Bayswater)** *submits two circuit diagrams, one showing the principle on which his apparatus is to be connected, and the other an actual drawing of an inside view of his instrument after it is wired, and asks if the latter is correct.*

We have carefully looked through the diagrams, in particular that of the actual wiring, and as far as we can tell this is quite in order. In this you have arranged for a reaction coil in series with the primary of the H.F. transformer, whilst this is not shown in the diagrammatic sketch, in which no provision is made for reaction. The set seems to be suitably wired and should function correctly.

**"R.V.T." (Westminster)** *asks* (1) *Whether a single valve frame aerial set will give* **PCGG.** (2) *How tuning to various wavelengths is accomplished on the set.* (3) *For dimensions of a loose coupler, if necessary.* (4) *If the circuit shown in the issue of June 10th will work with a frame aerial.*

(1) Not **PCGG**, but it should give London broadcasting and local amateurs. (2) By adjusting the condenser in shunt across the frame. Not necessarily for the frame aerial set but in conjunction with an outside aerial it will give much better results. Suitable dimensions have been repeatedly quoted. (4) We are unable to judge

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which of the circuits in the article quoted you are referring to.

"**T.F.T.**" **(N.W.1.)** *submits a circuit comprising one detector oscillator valve followed by two note magnifiers, and asks for criticism of circuit, particularly as to its suitability for the reception of telephony.*

Your circuit is incorrect. When using a common high tension battery for several valves, you must put all intervalve transformers on the plate side of the battery. As connected at present, all the plates are fed through the first intervalve transformer, which may give rise to howling. Also do not bridge both H.T. battery and transformer primary with one condenser, but bridge both with separate condensers. You should connect the aerial tuning condenser in series with the aerial tuning inductance, and this will give you more inductance in circuit to tune to a given wavelength, and consequently a bigger potential will be stepped off for operating the detector valve. The reaction coil should be bridged with a tuning condenser having air dielectric and a maximum value of 0·0005 mfds.

"**C.B.**" **(Ipswich)** *is desirous of adding a single valve amplifying set to that shown in Fig. 1, and asks whether H.F. or L.F. would be recommended, and for a diagram showing how the amplifier should be connected.*

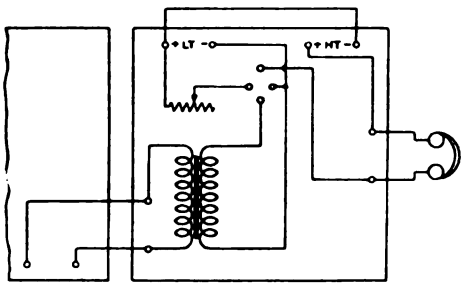


*Fig. 5.*

With only one additional magnifier, we recommend that it should be of the low frequency type, and the method of connecting is shown in Fig. 5.

"**BENCLAY**" **(Port-Madock)** *asks (1) For the wavelength of a certain loose coupler. (2) For information in regard to a certain transmitting set.*

(1) This coupler will be suitable for tuning to about 2,000 metres. (2) We regret we have no information about this set.

"**F.A.**" **(Tottenham)** *asks (1) If a certain crystal set is correctly wired. (2) If telephones marked "40 w" are suitable, and what the figures stand for. (3) If he should be able to get signals. (4) If any rearrangement should give him signals.*

(1) We cannot say from the type of sketch you send. For instance, your potentiometer appears to have five terminals, but there is nothing to show us the relation each of these terminals bears to the internal wiring. (2) The telephones are unsuitable for use except with a telephone transformer. The figures give the resistance of the windings, which in this case are low. (3) No signals are likely without change as in 2, but we cannot say whether results will then be obtained. (4) Arrangement as in Fig. 1, page 404, June 24th issue, would give atisfactory results.

"**D.J.**" **(Tankerton)** *has submitted a circuit to the Post Office for approval, consisting of one valve arranged to give high frequency amplification, followed by a detector valve, the plate circuit of which is coupled back to the aerial circuit, which has been rejected, and asks for a suitable circuit, making use of two valves, and arranged to give high frequency amplification.*

See the diagram, Fig. 6.

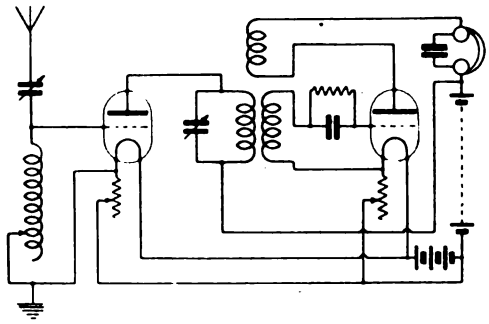

*Fig. 6.*

"**F.M.**" **(N.4)** *is constructing a long range single valve receiver on the lines described in the issue of February 5th, 1921, and has submitted the circuit shown on page 781 to the Post Office for approval, in making application for a receiving permit. He has been informed that the circuit, which is the usual single valve reaction arrangement, cannot be approved, and asks for a suitable circuit diagram.*

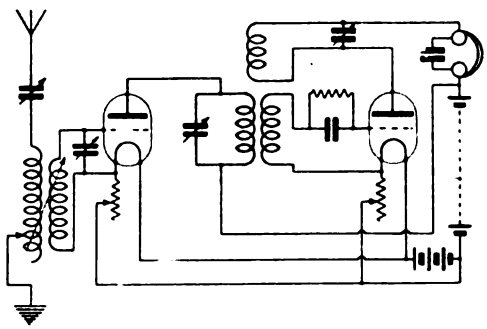

*Fig. 7.*

There would seem to be some doubt at the moment as to the type of circuit that one is permitted to adopt. The circuit you refer to is very extensively used and is the one usually recommended to beginners, though, of course, it is liable to give rise to serious interference as the number of users increases, and we appreciate the action of the Post Office in now forbidding its use. Re-radiation can be considerably reduced by using a two-valve circ it as shown in Fig. 7, in which the plate circuit of the second valve is coupled back to the intervalve high frequency transformer, and we have no doubt that the Post Office will be prepared to give you permission to use such a circuit.

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**"B.W.H." (Widnes)** 1) *Submits a circuit of a five-valve high frequency amplifier, giving values of all components, and asks for criticism.* (2) *Submits a circuit of a five-valve amplifier consisting of two H.F. transformer coupled valves and three note magnifiers, and asks for criticism.* (3) *How to add three stage H.F. amplification to the Armstrong super-regenerative circuit.* (4) *Values of the components in building up the set.*

(1) You do not say the wavelength on which it is intended to obtain H.F. amplification, and presumably you have tested the use of 150 turns as being suitable for your purpose; but we are of opinion that 150 turns is only suitable up to wavelengths of 400 metres. Your circuit in principle is quite good for switching from transformer coupling to resistance capacity coupling. You could simplify it, however, by leaving the grid condensers marked C2 in circuit all the time without detrimental results, provided suitable valves are used. In amplifiers of this sort, it is essential that all H.F. valves are similar in characteristic and specially designed for the purpose. We would suggest the use of "V24" valves for H.F. amplification, a "Q" as detector, and a "QX" as note magnifier. A condenser of 0·001 mfds. should be bridged across the primary of the transformer T2. Resistances R1 and R2 must be very carefully constructed, and must be of uniform and constant value. The L.T. and H.T. voltage will depend upon the type of valve used. The direction of winding of the transformers is important. If both primary and secondary are in the same direction, the leads which pass from one end are taken to grid and plate. You do not provide for reaction, and this can easily be done if so desired by winding a small coil 1" in diameter with No. 38 S.S.C. wire, and connecting it in the grid circuit of the last oscillator valve and placing it near the end of the first or second H.F. transformer. (2) This circuit is quite in order, but why not provide break jacks at 3B, in order to disconnect the low frequency valves, and so obviate the necessity for turning off the filaments? H.F. amplification can easily be added to the super-regenerative circuit by replacing the telephones and the condensers at the primary of an oscillation transformer and working from common H.T. battery on similar lines to the method which you show in your circuit diagrams. (3) We do not think, however, that the circuit is particularly suited to H.F. amplification, as the action of the separate oscillator is to produce considerable damping at rapid intervals. (4) By the use of the coils in the aerial circuit, the closed circuit and reaction coil are such as will tune in the wavelength required, and as are used in a loose coupled reaction tuner. The coils, however, which are connected in the grid and plate circuits of the oscillator valve are of a value that will produce oscillations just above audible frequency. We regret we cannot advise you more fully upon the operation of this circuit until more information comes to hand.

**"C.D." (W.1)** *submits a circuit diagram of a five-valve receiving set, also a drawing of a proposed design of the instrument, and asks for criticism.*

The principle of the circuit is quite good, and the method of switching in the various amplifiers should be satisfactory. We would suggest that the high frequency transformers be arranged on some interchangeable plug-in scheme. The primary circuit of these transformers should be tuned with small variable condensers, which have a maximum value of about 0·0001 or 0·0002 mfds. As switches are being provided for various apparatus, it would be a good idea to arrange one for connecting the aerial tuning condenser either in series or parallel with the aerial tuning inductance. The reaction coil should be bridged with a tuning condenser having a maximum value of 0·0005 mfds., and all variable condensers should have air dielectric. Slightly better results would be obtained were an independent aerial circuit adopted, to which a secondary is coupled, and carried on to the terminals marked B and G. You do not show the construction of the coils, but we would recommend you to adopt single layer coils for short wave, and multilayer coils for long wave, and connected in circuit by means of plugs. Your telephones are marked low resistance, whilst by the action of the switches you intend to connect them across the secondary of the intervalve transformers. These transformers are of the step-up type, and have very high resistance secondary windings, quite unsuitable for operating low resistance telephones. An easy arrangement, instead of using switches, is to use break jacks, and terminate the telephones on a plug. The insertion of the plug in the various jacks connects or disconnects valves as required, or alternatively the plate lead of the rectifier valve may be brought to the arm of a three-stud switch. The contacts of the three-stud switch are taps on to the primaries of the L.F. transformers. It is not necessary to bridge the last two transformers with fixed condensers. With regard to the actual design of the apparatus, this appears to be rather neat but somewhat complicated, and it does not permit of the fitting of all components to an ebonite panel which can be withdrawn complete from the woodwork. It is not an advantage, as a rule, to incorporate the accumulator inside the set, as its acid and acid fumes are liable to be detrimental to the insulation. By sloping the panel as shown, you considerably reduce the amount of accommodation inside the box, though we presume this has been considered and ample space provided. Special valves should be used for the various purposes, and the detector valve should be one giving good rectification. Potentiometer control might be arranged for the two H.F. valves, and also for the detector valve.

**"NOVO" (Ipswich)** *asks* (1) *If there is any advantage in spacing the turns of wire for an inductance.* (2) *What capacity of variable condenser is required for a certain coil.* (3) *How many fixed and moving vanes and what size.* (4) *If a potentiometer and battery is an advantage with a "Hertzite" crystal.*

(1) It may make a few per cent. difference in efficiency, but is not important. (2) It depends more on the circuit than on the coil it is to be used with. If the aerial circuit 0·001 mfds. in series with the coil; if for the closed circuit 0·0005 mfds. in parallel. (3) 4" diameter plates, 1 mm. apart for the 0·001 mfds., 15 fixed and 14 moving; for the 0·0005 mfds. half this quantity. (4) We have no experience of this crystal.

**"H.M.W." (Kirton Lindsey)** *possesses one single valve detector panel, one transformer marked earth to valves, two intervalve transformers, one*

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*telephone transformer, one grid leak and condenser, 4 Osram valves with holders and filament resistance, one pair of 2,000 ohm telephone receivers, two variable condensers of 0·001 and 0·0005 mfds., and also 1lb.*

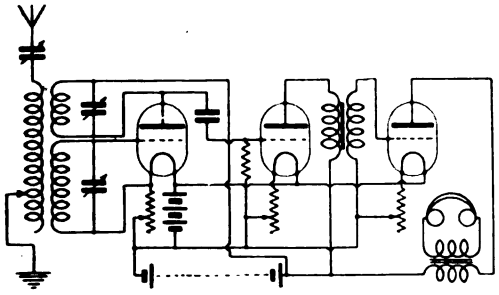

*Fig. 8.*

*of No. 36 D.C.C. wire, and asks for a suitable circuit for reception of Hague concerts on a single wire aerial. 85′ in length.*

For circuit see diagram Fig. 8.

**"W. D." (Blackheath)** *asks (1) The wavelength range of his set, which consists of tuned aerial circuit with coupled secondary and reaction coils. (2) Number of plates for variable condenser of 0·001 mfds., and if there is a formula for working out the number of plates for various capacities. (3) Area of tinfoil for making fixed condenser 0·001 mfd. (2) Dimensions for constructing transformer for use with crystal set for short wavelengths.*

It is impossible to advise you on the wavelength range of your set without knowing the dimensions of your aerial. However, the ratios of windings of the various coils would appear to be satisfactory and it is quite easy to determine the wavelength range by identifying the stations which are tuned in. You should arrange to connect the aerial tuning condenser either in series or parallel with the aerial inductance, and if this is done, the wavelength range would probably be from 200 to 850 metres when connected to a two-wire aerial of the maximum dimensions specified by the P.M.G. (2) If the moving plates have a diameter of 2¼″ and are No. 20 S.W.G. in thickness, and the spacing washers 3/32″, you will require approximately 25 movable and 26 fixed plates to give a capacity of 0·001 mfd. Other capacities are directly proportional. (3) Three plates, being two in one direction and one in the other, ruby mica dielectric 0·002″ in thickness and with an overlap of 3·5 sq cm. (4) We presume you mean an oscillation transformer, and we cannot give precise dimensions without knowing the size of aerial on which you propose to connect it. However, 1¼″ of winding with No. 24 D.C.C. and a 3½″ former will tune the two-wire aerial from 180 to 600 metres with series condenser of 0·001 mfds. The closed circuit which would slide inside should consist of 1¾″ of winding of No. 28 S.S.C. on a 2¾″ former, and be bridged with a tuning condenser of 0·0005 mfds.

**"T.R.K." (Pontypool)** *is constructing the American short wave receiver described on page 281 of the June 3rd issue, and wishes to know how to extend the wavelength range up to 1,050 metres, at the same time permitting efficient reception on short wavelengths.*

The apparatus is designed especially for short wave reception and the variometers in grid and plate circuits cannot be constructed to give a wavelength range from 100 to 1,000 metres, and for reception on the longer wavelengths we recommend you to adopt a different circuit. Alternatively you might bridge the plate circuit variometer with av ariable condenser having a maximum capacity of 0·0004 mfds., and also arrange by means of a switch that will avoid dead end effect, to treble the number of turns connected in the secondary of the oscillation transformer. This secondary, together with its variometer, might then be bridged by a variable condenser. You will probably find, when connected to your aerial, that the aerial tuning circuit will tune to over 1,000 metres when the aerial inductance is connected in parallel with an aerial tuning condenser. If it does not give the required range, a few more turns might be connected in series externally. When tuning the grid and plate circuits to the longer wavelengths, you may find that insufficient reaction is provided for the reception of continuous wave, and should this be so, an additional variometer will have to be constructed for the purpose of coupling together grid and plate circuits. I think you would find it much easier to construct an independent receiver.

**"R.B.K.M." (Cirencester)** *asks re the American short wave receiver of the June 3rd issue (1) Whether the condensers need be variable. (2) What their capacity should be.*

(1) These condensers may be fixed if desired, although the variability of the grid condenser might be a slight advantage. (2) Capacities may be, grid condenser 0·0003 mfds. telephone condenser 0·001 mfds.

**"W.J.L." (Sheffield)** *asks (1) (a) Maximum and minimum wavelength of a set described; (b) Size of reaction coil. (2) Sketch of dead-end switch. (3) If the terminals of a valve panel are correct in sketch enclosed. (4) Wavelength of a duolateral coil with a 0·001 condenser.*

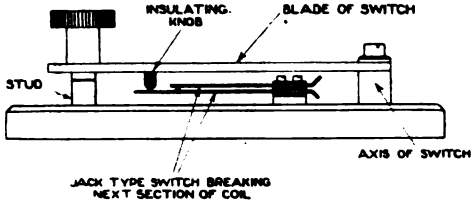


*Fig. 9.*

(1) Maximum wavelength about 2,000 metres. (b) As large a coil, wound with No. 36 single layer as will swing inside the A.T.I. (2) See Fig. 9. (3) The suggested arrangement will do fairly well, but why have A and E so far away from the A.T.I. ? (4) If you use only 30 turns as suggested the wavelength will be very small, perhaps 50 metres. If you use 30 layers the wavelength will be of the order of 10,000 metres.

**"H.W.E." (Halesworth)** *asks which is the very best receiving set he can purchase, irrespective of price, for use on a single wire aerial of 100′ long by 60′ high. He intends to use a loud speaker, and*

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*the apparatus is to cover the complete wavelength range.*

It is regretted that we cannot advise you on the merits of the wireless apparatus at present on the market. If you make a point of arranging for the demonstration of the apparatus you propose to purchase, it is quite easy to judge its merits. We would suggest that you adopt a tuning arrangement comprising aerial coil, closed circuit coil, and reaction coil, with variable tuning condensers, on e of 0·0015 and two of 0·0005. Inductances of the plug-in type can be obtained to cover the full wavelength range. The rest of the apparatus might be purchased in the form of units, which will permit of making alterations as they may be required from time to time. You might adopt two high frequency amplifying valves with interchangeable transformers for wavelengths up to 2,500 metres, after which resistance-capacity amplification might be adopted. These two amplifiers should be followed by an efficient detecting valve, the grid of which may be provided with potentiometer control. After the detector, three note-magnifying valves might be connected Great care should be taken in selecting thoroughly efficient intervalve transformers. You should be careful in the selection of a loud speaker, with a view to obtaining one which gives a minimum of speech distortion.

**"J.E." (Blackburn)** *is constructing the apparatus shown on page 318 of the June 10th issue for the charging of accumulators from A.C. mains, and asks for details of step-down transformer for use on a 230-volt supply.*

It is presumed that the periodicity of the supply is 50, in which case you can make a closed core transformer in which the core, consisting of a number of flat plates, should have a cross sectional area of at least three square inches. The secondary should be wound on first, and consist of three layers of No. 18 D.C.C., whilst the primary should consist of 16 layers of No. 22 D.C.C., the length of winding in each case to be 5". It is advisable to connect in series with this transformer a variable choke coil consisting of about eight layers of No. 20, on a bundle of iron wires 1" in diameter, by 5" long, and tapped out at each layer. We do not recommend the apparatus for giving long runs when passing a current exceeding 2 amperes.

**"H.G.L." (Gravesend)** *wishes to make use of a 3-coil holder, and submits two proposed circuits, and asks* (1) *If they are correct, and whether he may dispense with the tuning cnodensers across the reaction coil.* (2) *What make of valve would be advised for use in the circuit, and the best type of crystal.* (3) *Values of condensers required for tuning inductances, and* (4) *Whether his apparatus is suitable for the reception of telephony.*

(1) Your circuit No. 2 is quite correct, though you will find tuning rather difficult after the use of the reaction tuning condenser, and particularly will you find it difficult to tune in telephony on short wavelengths. (2) "R4B," perikon (copper pyrites and zincite) or synthetic galena. (3) For short wave tuning, aerial tuning condenser should be connected in series with aerial tuning inductances, and have a maximum value of 0·001 mfds. For finer tuning, and for still further reducing the wavelength, a fixed condenser having a value of 0·001 mfds. might also be connected in series with the variable condenser and the inductances. The condensers for tuning the closed circuit and the reaction circuit should have a maximum value between 0·0004 and 0·0005. All condensers should be of the air dielectric type. At Gravesend you should certainly be able to receive most of the experimental London telephony, but the addition of one note-magnifying valve is to be recommended, as it would render the telephony much more comprehendable.

**"W.A.C." (Herne Hill)** *submits a circuit consisting of oscillator valve with tuned grid and plate circuits, with crystal potentiometer and transformer connected across the ends of the reaction inductance, and with the secondary of the transformer connected to a note magnifying valve, and asks if it is correct, as he is unable to obtain results.*

The circuit would appear to be correct, excepting perhaps that one lead from the secondary of the transformer should be taken to the L.T. minus instead of the L.T. plus, but this may be an error in the preparation of your diagram. Without more particulars it is impossible to suggest the cause of trouble. The small condenser which you show between grid and plate for the purpose of producing electrostatic reaction is hardly necessary when inductive reaction is provided. You should attempt to obtain results with a single valve receiver only, omitting crystal and note magnifier. Try connecting your telephones and telephone transformer in the lead between H.T. plus and reaction circuit. When this functions correctly, you might add the crystal and then the note magnifier.

**"W.W.M." (Grimsby)** *asks* (1) *If circuit sketched is suitable for both "Q" and "V24" valves.* (2) *If a grid leak and condenser is necessary, and if so where it should be put.* (3) *What value H.T. would be necessary.*

(1) The circuit is quite O.K. except that the grid circuit of the second valve should go to the negative of the L.T. instead of the positive. "V.24" and "Q" may be used together off about 40 volts, if the "Q" is used for rectifying. Used in this way the circuit is best without a grid condenser and leak to the rectifying valve. (2) It might be put in the grid circuit of the "V.24," but is not at all necessary. (3) For a resistance capacity coupling, increase the voltage to about 70.

## SHARE MARKET REPORT

Prices as we go to press, August 18th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 8 | 0 |
| ,, Preference .. .. | 2 | 6 | 10½ |
| ,, Inter. Marine.. .. | 1 | 10 | 7½ |
| ,, Canadian .. .. | | 10 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 0 | 9 |
| Preference .. .. .. | | 14 | 4½ |

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THE
WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 23. SEPTEMBER 2ND, 1922. WEEKLY

# Practical Data for Building the Armstrong Super-Regenerative Circuit

By EDGAR H. FELIX, Associate I.R.E.

AS soon as Major Armstrong demonstrated his discovery of the super-regenerative circuit before the Institute of Radio Engineers, there was an immediate rush to build sets embodying the principles he had explained. "As soon as" is not exaggeration, for at the close of the meeting several enthusiastic engineers hailed taxicabs and hastened to their laboratories to try the new circuits.

Lacking detailed information as to constants of circuits, many of the most skilled engineers have had difficulty in getting satisfactory results.

Since the article describing the super-regenerative circuit appeared in *The Wireless World and Radio Review*, I have received letters from British amateurs requesting constants of the various instruments used in the circuits. Because of their desire for information, I here describe in detail the set built by Major Armstrong and used for demonstration at the Institute of Radio Engineers. Fig. 1 is a photograph of the equipment.

The set employs three valves and secures results approximating those obtainable with a super-heterodyne set employing ten valves. Of the super-regenerative circuits, it is the most easily operated because each function of the circuit—regeneration and amplification, variation of negative resistance and detection—is performed by a separate valve and a separate valve circuit, each adjusted independently of the others.

It is inadvisable for an amateur to attempt the operation of a super-regenerative set except he be thoroughly familiar with the operation of an ordinary regenerative circuit. Super-regeneration adds a new series of sounds. The amateur must learn to recognise these and become experienced in making the proper adjustment called for by each sound. With the three valve circuit it is less difficult to analyse the cause of these and make the proper adjustment to correct them than it is with sounds representing frequencies caused by the interaction of the various circuits combined in one or two valves.

Major Armstrong recommends that super-regeneration be attempted only with a loop antenna. In adjusting the circuit, numerous frequencies which interfere with reception by other stations are radiated from an antenna. Therefore, the suggestion that an antenna for receiving with the Armstrong super-regenerative circuit should not be used and that the loop should be employed.

Only "hard" valves should be used—that



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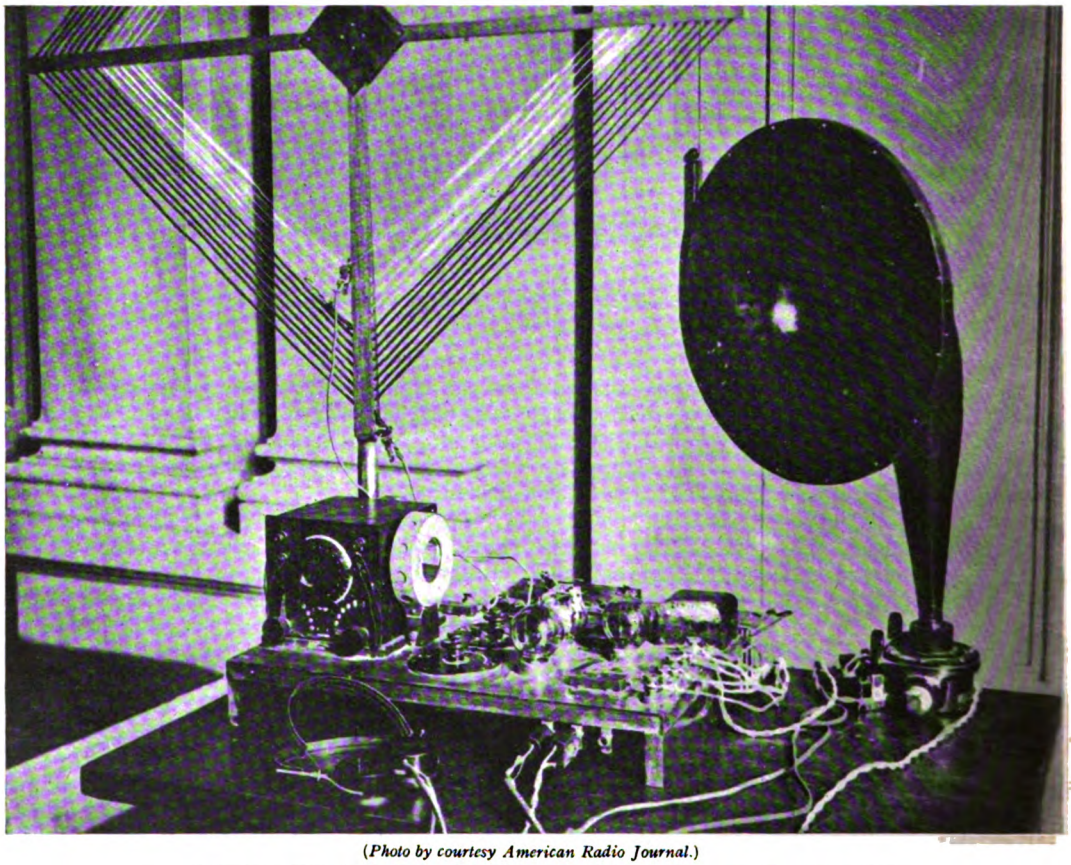
is, valves without any appreciable gas content. Since the limit of amplification with this circuit is the maximum output of the valves themselves, five-watt power valves are recommended instead of receiving valves.

In my first article, explaining the principles of the circuit, I stated that the efficiency of the super-regenerative system increases inversely as the square of the wavelength. The upper limit of satisfactory working is 1,000 metres. Extraordinary efficiency is obtained on the 360 metre wave upon which



(*Photo by courtesy American Radio Journal.*)

*Fig.* 1. *Receiving Set embodying the Super-Regenerative Circuit.*

American broadcasting operates. At 50 metres efficiency is greatly augmented.

Fig. 2 is a diagram of Major Armstrong's receiving set. The loop in these tests consists of ten turns mounted on three foot square frame.

The tuning element consists of the stator of the conventional vario-coupler. The one shown in the photograph is a " Grebe " vario-coupler. A typical vario-coupler is $3\frac{1}{2}$ inches in diameter with a winding of 100 turns tapped at each ten turns.

The amplifier or regenerative valve circuit includes the secondary vario-coupler, shunted by a variable capacity. The rotor of the vario-coupler is used as the reaction or feed back coil. The reaction coil should be double the usual inductance of a reaction coil. 125 turns of 26 wire is satisfactory for the purpose.

The variable capacity, $C_1$, for tuning, is of 0·001 mfd. capacity. Nevertheless, half that capacity is sufficient with most sets. A negative battery, $B_1$, is substituted for the usual grid condenser and grid leak. This battery should be variable from zero to five volts, in order that the value most effective for the particular valve used may be determined.

Because of the periodic action of the oscillator valve in preventing the generation of oscillations by the oscillator valve circuit

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and the consequent prevention of valve paralysis, unusually high plate voltages are used. The limit of plate voltage useable is determined by the voltage capacity of the valve itself. For this reason, use a plate battery supplying from 80 to 100 volts.

The oscillator valve circuit is coupled to the amplifier valve circuit through the tap at the top of the vario-coupler. In most cases, the best results are obtained by tapping the very top turn of the vario-coupler. However, if the utmost is desired, test each turn from the top to the fifth turn from the top after the circuit is operating properly. In some cases better results are obtained slightly below the top of the coil. The coupling to the oscillator circuit is completed by the filament connection.

by the second valve is determined by the adjustment of $L_3$ and $C_3$. Once a proper value has been determined it does not require readjustment.

Major Armstrong uses a duolateral coil of 1,250 turns, shunted by a variable capacity of 0·0025 mfd.

The plate circuit of the oscillator valve is coupled to the grid circuit through $C_2$, a variable condenser of 0·001 mfd. capacity. A 5 millihenry air choke coil keeps out the audio-frequency oscillations. The adjustment of $C_2$ determines the amplitude of the oscillations generated.

The plate potential for the oscillator valve is supplied through the filter circuit from the generator valve.

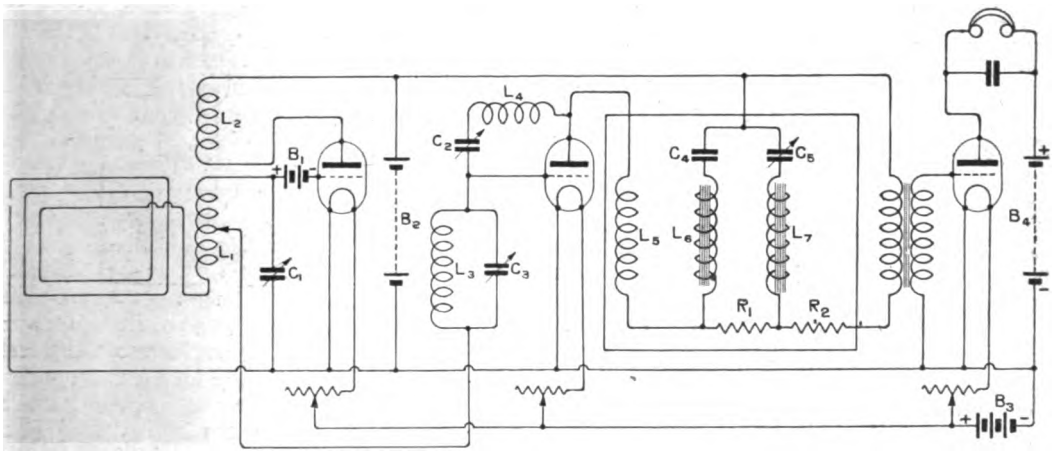


*Fig. 2. Three-Valve Super-regenerative Circuit.*
$L_1$ = *Tuning inductance.*
$L_2$ = *Reaction coil.*
$C_1$ = *Tuning condenser,* 0·001 *mfd.*
$B_1$ = *Grid battery,* 0-5 *volts.*
$B_2$ = *Plate potential battery,* 80-100 *volts.*
$C_2$ = *Oscillator tube circuit coupling capacity,* 0·001 *mfd.*
$L_3$ = *Oscillator inductance, DL.* 1,250.
$C_3$ = *Oscillator capacity,* 0·0025 *mfd.*
$L_4$ = *Choke coil,* 5 *milli-henries.*
$L_5$ = *Choke coil, DL.* 1,500.
$L_6$, $L_7$ = *Iron core choke coils,* 1 *henry.*
$B_3$ = *Filament lighting battery.*
$B_4$ = *Plate potential battery,* 200 *volts.*
$R_1$, $R_2$ = *Resistances,* 12,000 *ohms.*
$C_4$ = *Fixed condenser,* 0·005 *mfd.*
$C_5$ = *Variable condenser,* 0·005 *mfd.*

In this circuit the negative resistance of the regenerative circuit is varied by changes in the positive resistance of the circuit. When the oscillator valve is conductive, it practically short circuits the secondary inductance; when the oscillation reverses in the oscillator valve circuit, its resistance rises to a high value.

The frequency of the oscillations generated

The filter circuit consists of a 1,500 turn duolateral coil in series with two 12,000 ohm non-inductive resistances. Two iron core choke coils of one henry inductance, in series, respectively, with a 0·005 fixed capacity and a 0·005 variable capacity, complete the filter circuit. Satisfactory results may be obtained without choke coil $L_6$. Any suitable

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filter circuit may be substituted for the one shown in Fig. 2. For this reason it is enclosed with lines.

The output of the generator and oscillator valve is supplied to the usual audio-frequency transformer, which, in turn, makes the audio-frequency currents available to the detector tube. The detector circuit is conventional, except that an unusually high plate potential is supplied by a 200-volt plate battery.

The first adjustment in operating this circuit is tuning to the incoming signal by means of $C_1$. The oscillator valve is then set into action by a correct adjustment of $C_2$. The reaction coupling is gradually increased as soon as the familiar click, indicating that oscillations are being generated by the oscillator valve is heard in the telephone receivers. A re-adjustment of $C_1$ is usually required to effect more exact tuning. Adjustments of $C_3$ and $C_5$ need be made only once; when the correct values are found no subsequent adjustment is necessary.

In some cases, a reversal of the filament lighting battery, $B_3$, improves the signal strength. If satisfactory results are not obtained at a time when the circuit is otherwise operating properly, try reversing the battery connections.

Fig. 3 shows a super-regenerative circuit in which all the functions are performed by a single valve. This circuit was set in operation in a steel frame building, 25 miles distant from the nearest broadcasting station transmitting at the time of the test. Employing a loop antenna, the signals received were so loud that they completely "paralysed" the head telephones. Using a loud speaker, music was easily heard in all parts of a large lecture hall.

This circuit requires the utmost delicacy of adjustment and it will satisfy the most insatiable appetite for feats of technique in adjustment. The same vario-coupler as previously described was used for $L_1$ and $L_2$; $L_3$ and $L_4$ are duo-lateral coils of 1,250 and 1,500 turns respectively, shunted by 0·0005 mfd. variable capacities. The plate potential is 80 volts. $C_4$ is fixed of 0·005 capacity; $C_5$ of 0·001 capacity; the resistances are 12,000 ohms; the iron core choke of one henry inductance.

No doubt within a few months hundreds of successful super-regenerative receivers will have been built by amateurs and descriptions of simpler circuits and more specific data will be available. Although considerable patience is required in learning to adjust the circuit, the almost incredible results obtainable make the effort well worth while.

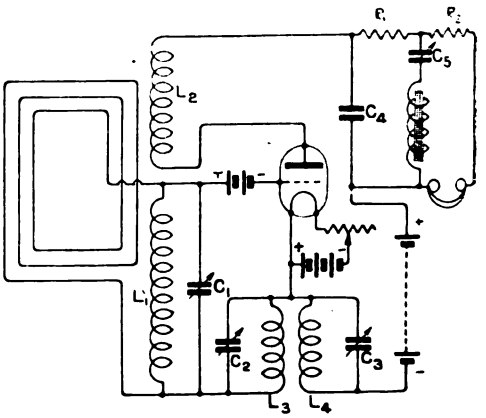


*Fig. 3. One Valve Super-regenerative Circuit.*
$L_1$ = *Tuning inductance.*
$L_2$ = *Reaction coil.*
$C_1$ = *Tuning capacity,* 0·001 *mfd.*
$C_2$ = *First oscillator circuit capacity,* 0·005 *mfd.*
$L_3$ = *First oscillator circuit inductance, DL.*1,250.
$C_3$ = *Second oscillator circuit capacity,* 0·005 *mfd.*
$L_4$ = *Second oscillator circuit capacity, DL.*1,500
$C_4$ = *By-pass capacity,* 0·005 *mfd.*
$C_5$ = *Filter circuit capacity,* 0·001 *mfd.*
$R_1$, $R_2$ = *Resistances,* 12,000 *ohms.*

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The Wireless Exhibition and Convention
AT THE HORTICULTURAL HALL
WESTMINSTER, S.W.

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# Experimental Station Design

*Continued from page 662, August 19th, 1922.*

*These articles, which appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the Experimental Station. Actual designs are of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions are given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony, and consequently may cover ground already familiar to many readers. The succeeding instalments, however, advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## XI.—HIGH FREQUENCY INTERVALVE TRANSFORMERS.

WHEN great receiving range is desired it is necessary to adopt amplification at radio frequency, that is, the amplitude of the oscillations is increased prior to rectification by the detector valve. High frequency amplification does not produce such an increase in signal strength for each high frequency valve circuit added as low frequency amplification. The former will bring in signals though perhaps weak, which any amount of low frequency amplification alone would not render audible, because a certain oscillation strength is required to operate a detector valve.

One of the simplest forms of H.F. transformer is shown in Fig. 1. This consists of two basket coils of the type described on page 328, June 10th, 1922, issue. The coils are held together by means of a small bolt passing through the centre which also serves as a support. Two coils, one for primary and one for secondary, will give a transformer suitable for use on wavelengths of about 220 metres, whilst two coils in series for the primary, and two for the secondary, is suitable for wavelengths of 300-450 metres. A piece of waxed paper should be placed between the coils and when four or more coils are used primary and secondary coils should be assembled alternately, taking care that the direction of winding is not reversed in consecutive primary or consecutive secondary coils. A good way of doing this, when assembling four coils, is to lay them out with their beginning ends all pointing in the same direction. Two coils are then lifted, one over the other, a hole being pierced in the top one for the purpose of passing through the inside end of the lower one. Another coil is then pierced with two holes, *turned over*, and placed on the other two coils passing the two inside wires through the holes. The lead which passes from the bottom coil is then connected to the inside lead of the

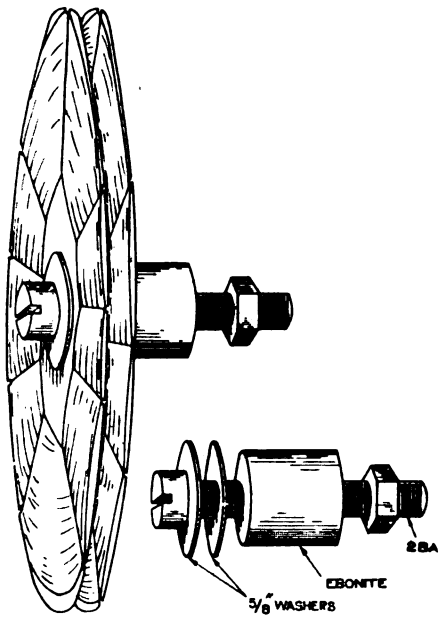


*Fig. 1. Transformer consisting of two basket coils wound on card support and clamped together.*

third coil and the joint wrapped with insulating material. The last coil, having one hole pierced in it, is then *turned over* and placed on the other three with the inside lead from the second coil passing through the hole. This lead is then connected to the inside lead

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of the last coil and insulated. The insulating paper must, of course, be placed between the coils as they are assembled. A 2 B.A. brass bolt now passed through the centre, taking care to avoid the connecting wires, will clamp the coils closely together and provide tight coupling. It is desirable, in high frequency transformers, that they shall have reasonably

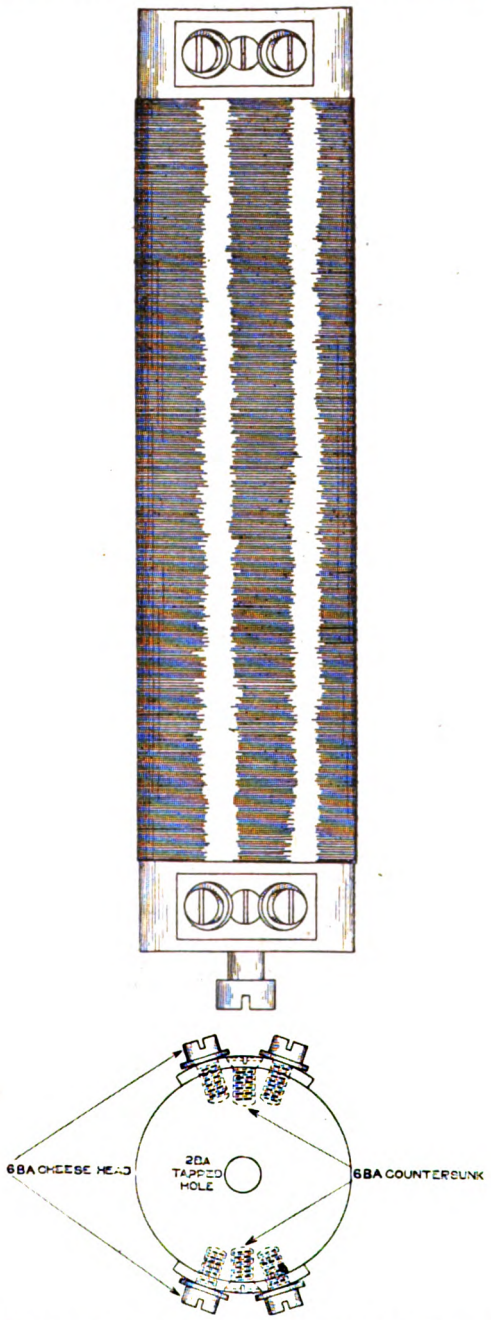


*Fig. 2. The single layer type, wound on ebonite rod.*

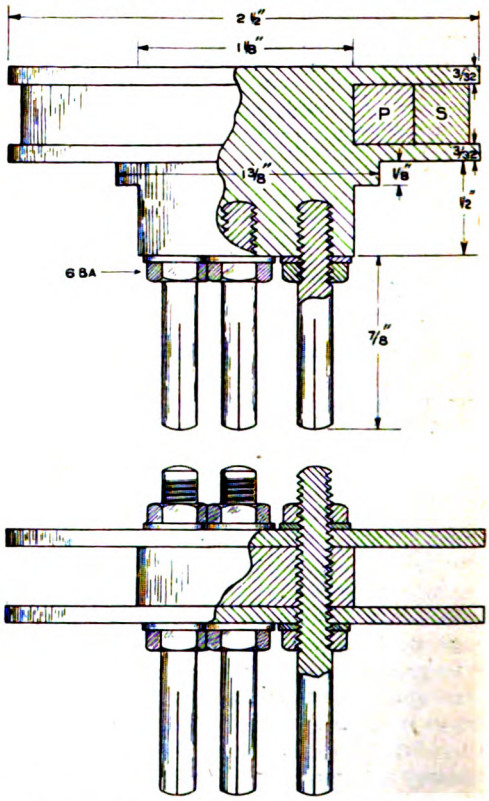


*Fig. 3. Two types of interchangeable H.F. Transformers.*

low self capacity in order that they may operate over as wide a band of wavelengths as possible. Basket coils are well known to possess very low self capacity whilst the method of assembling just described eliminates any appreciable increase in self capacity owing to the spacing between consecutive primary or secondary coils. On the other hand, the particular arrangement not only gives very tight coupling but gives maximum capacity between primary and secondary windings which is a very desirable property in H.F. transformers. Insulation between primary and secondary is very important as there is a difference of potential between them equal to that of the H.T. battery, and the particular design permits of good insulation being ensured.

The method of connecting high frequency transformers in circuit is shown in most of the very many circuits given in this journal,

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but the direction in which the windings are connected up is important, in order to obtain maximum grid potential fluctuation and also to provide maximum capacity coupling between plates and grids of consecutive valves.

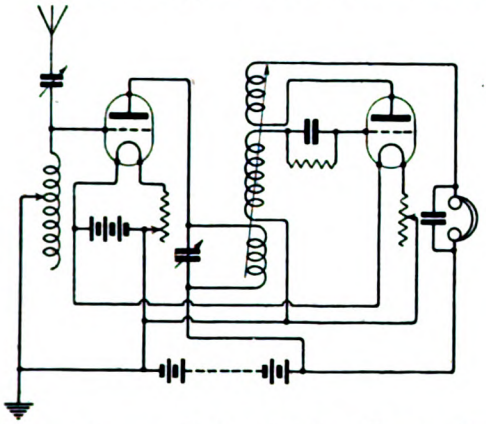

*Fig. 4. A non-radiating circuit. The reaction coil is coupled to the H.F. Transformer windings.*

In the case of the transformer just described, all leads will pass out from the outer edges of the coils. The lead from the first coil is taken to H.T. +, the lead from the next to L.T. — or potentiometer or in special circumstances to the L.T. +, the next to plate and the last to grid.

A high frequency amplifier making use of several high frequency valve circuits must have its transformers of such a design that they can be relied upon to all have identical inductive values or otherwise, one slightly different to the remainder, will filter out signals on which the others would give best amplification. H.F. transformers consisting of basket or single layer coils can be relied upon to be identical. In the case of windings that are run on into slots, the inductance will depend not only on the number of turns but very considerably upon the method and tightness of the windings, consequently it is only possible to give accurately, transformer windings for particular wavelengths when of the type described above or in the form of single layers.

Another type of transformer is shown in Fig. 2. The former on which the windings are arranged is a piece of $1\frac{1}{8}$ ins. diameter polished ebonite rod. The windings terminate on screw tags and consist of single layers of fine single silk-covered copper wire, between 36 and 42 S.W.G. The wavelength range can be slightly broadened by winding with No. 44 S.W.G. or finer, S.S.C. resistance wire. Fine resistance wire is somewhat stronger than copper wire of a similar gauge and hence its use may be recommended as it is not so difficult to handle. A primary and secondary,

*Fig. 5. Transformer with reaction coil*

each of 280 turns, will give good amplification on wavelengths between 200 and 350 metres, whilst 450 turns is suitable for 300-500 metres, and 600 turns has an optimum wavelength of 600 metres. More than 600 turns in the form of a single layer will produce a transformer of excessive length and for greater wavelengths 2 ins. or $2\frac{1}{2}$ ins. ebonite tube must be used. With this style of transformer the two windings should be insulated from one another with a single layer of empire cloth, and both wound

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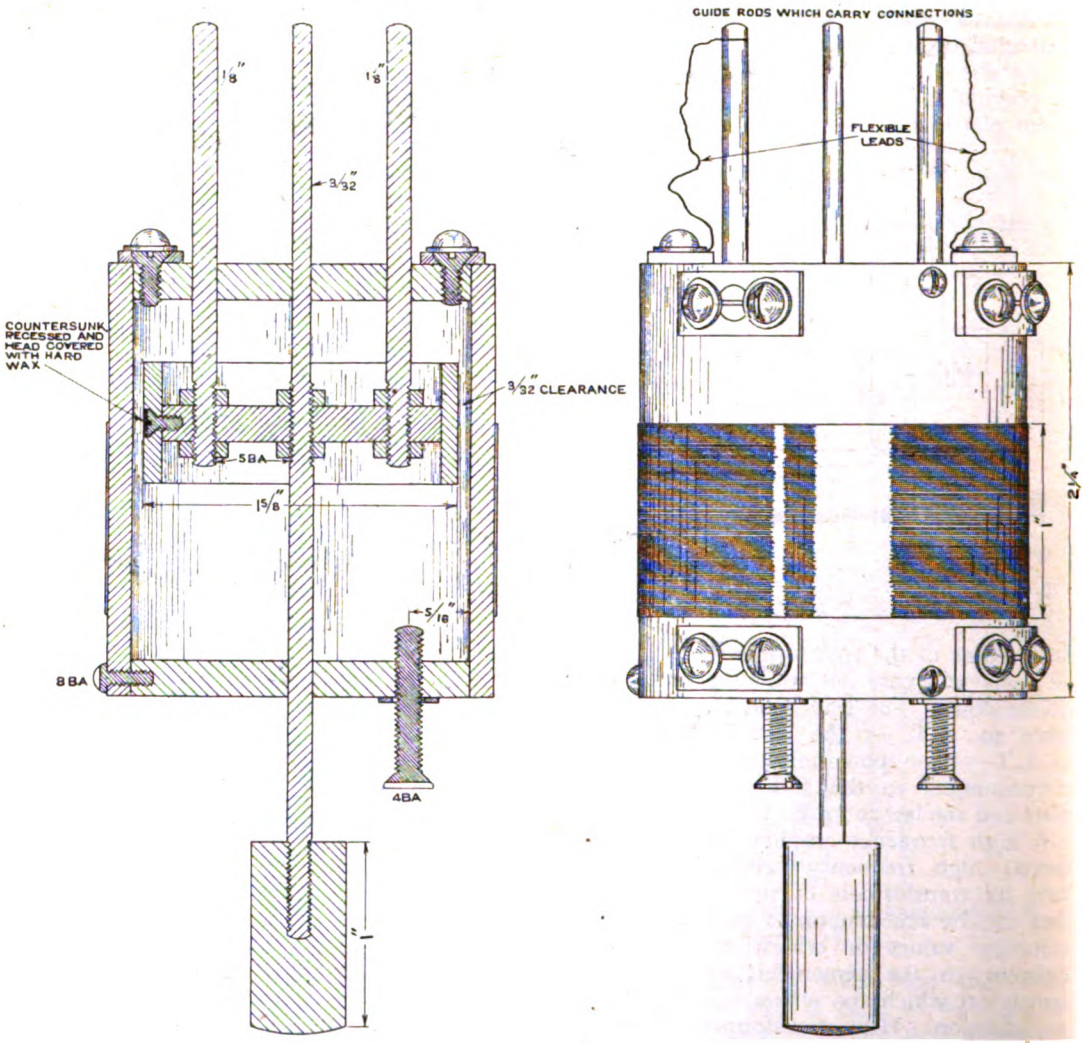


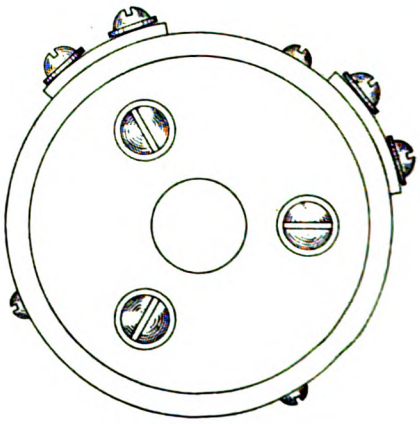

*Fig. 6 A design of H.F. Transformer for panel mounting with variable reaction coupling.*

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in the same direction. The leads which terminate at one end are connected to grid and plate.

Mention might be made of the type of transformer which has now become very popular, having a slot to carry the windings and a four-pin base for the purpose of rendering it interchangeable with others (Fig. 3). With this type of transformer it is much better to wind the primary and secondary separately instead of running the two wires on together, in order to maintain good insulation between primary and secondary as mentioned above. The two windings should be in opposite directions, the two leads which pass out between the windings being taken to grid and plate.

A type of transformer giving very good results can be made with the use of a coil winding machine by running on two wires simultaneously. Care must be taken to avoid the wires crossing, and if primary and secondary wires are of different colours the winding can be easily watched. Thus wound each successive turn of the primary winding is spaced with a turn of the secondary and consequently the self capacity is kept as low as is possible, whilst the capacity between the two windings is a maximum. If the transformer is of a mean diameter of 1⅝ in. and has primary and secondary each of 120 turns of No. 28 D.S.C., it will be suitable for operation on wavelengths between 300 and 470 metres. The two leads passing from the outside of the transformer are for connection to grid and plate. This type of transformer can be conveniently mounted between ebonite discs as shown in the lower drawing in Fig. 3.

Apart from the advantages already mentioned, H.F. amplification permits of the provision of inductive reaction in a receiving set without causing radiation. This is effected by providing a H.F. transformer between the first and second valves, to the windings of which is coupled a coil connected in the plate circuit of the second valve, as shown in Fig. 4. By extending the length of the transformer shown in Fig. 2, in order to allow a space of one or two inches free of winding and slipping over the transformer, a closely fitting ebonite tube carrying a single layer winding (Fig. 5) reaction can be arranged on to the transformer windings as indicated in the circuit diagram. With such an arrangement the secondary should be the outer winding of the two windings on the rod. The leads to the connectors can be buried in grooves cut in the surface of the former and filled in with hard black insulating compound.

An alternative design is shown in Fig. 6, so arranged that the extent of reaction can be readily varied when the transformer is mounted in the panel of a receiver. It is not necessary to give constructional advice in the making of this instrument, as the drawing is sufficiently detailed and the methods of working ebonite and brass have been explained in previous articles under this heading. Attention might be drawn, however, to the great care necessary in drilling and tapping the thin walls of the ebonite tube. The grid circuit winding is beneath the primary, both windings being in the same direction. The grid and plate connections are taken from the front end of the transformer. For a wavelength range of 300-450 metres, 170 turns of No. 38 S.S.C. is suitable for primary and secondary windings. When it is intended to tune the primary with a low capacity condenser which, it might be mentioned, should be of the air dielectric type, with a capacity of not more than 0·0002 mfds., the secondary or grid circuit may consist of an additional 20 turns to the number on the primary. The reaction coil should be wound with 120 turns of No. 42 S.S.C. Modifications in the dimensions of the formers can be made to suit various wavelengths up to 2,000 metres, beyond which the resistance capacity method of intervalve coupling is usually adopted. F.H.H.

## A Broadcasting Concert Platform.

*Miss Olive Jenkins, the famous Cornish Soprano, broadcasting from Marconi House, accompanied by Signor Mancio de Veroli.*

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# A Broadcast Receiver

*Continued from p. 683 of issue of August 26th, 1922.*

By A. J. BULL.

A glance at the photograph of the instrument, back view, Fig. 5, may assist to convey the idea of the spacing. Having wired the filament circuits, the intervalve transformer should be fixed in the position over the H.F. valve, as indicated in the double page diagram (pp. 680—681 of August 26th issue). A simple method of doing this with most transformers is to obtain a piece of brass, 4 ins. long × $\frac{3}{8}$ in. wide × 1/16 in. thick.

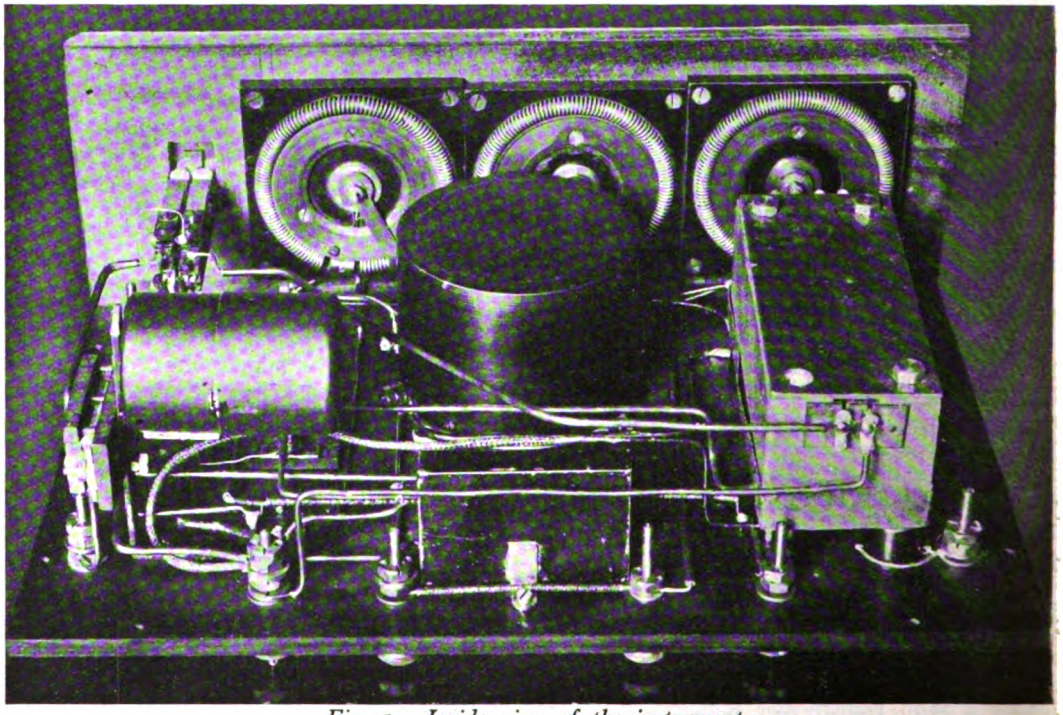

*Fig. 5. Inside view of the instrument.*

Measure off $\frac{3}{4}$ in. and make a right-angle bend. In the $\frac{3}{4}$ in. portion of the brass, drill two holes to take two 4 BA screws. With a 7/64-in. drill, bore two holes nearly through the ebonite panel in the position shown near the grid socket of the H.F. valve. As the reader views the panel in the double page diagram, this position will appear as about $3\frac{1}{2}$ ins. immediately above the sketch of the Dewar switch.

As stated earlier in the article, by drilling with a 7/64-in. drill, the 4 BA screws may be made to cut their own thread in the ebonite, thus ensuring a tight fit. Having screwed the right-angled brass in position, it should stand out $3\frac{1}{4}$ ins. perpendicular to the panel. To this the transformer is secured by means of two 4 BA screws. Underneath this transformer on the opposite side a 0·001 mfd. fixed condenser is fastened to the angle brass by a single 1-in. 4 BA screw. This screw first passes through the insulation of the condenser as shown in the top right-hand corner of the double page diagram. The function of this condenser, which is connected across whichever transformer is switched in circuit, is to provide a path for H.F. currents, when the reaction coil is employed, which current would otherwise be stopped owing to the impedance of the transformer.

The telephone transformer now calls for consideration. This can be secured to the panel in a manner similar to that followed for the intervalve transformer, or by a method to be now described. The transformer depicted in the full-sized diagram near the telephone terminal is a captured German one, purchased from disposals, and is enclosed in

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an iron case, which case provides a return path for the flux.

Four iron bolts, 2⅞ ins. long, threaded 4 BA for ¼ inch, pass through the case at the corners into the ebonite panel to a thread cut to receive them. Four spacing washers of ebonite ⅝ × ½ in. diameter, through which the bolts also pass, space the transformer ⅝ in. from the panel. In place of the telephone transformer, however, a pair of H.R. telephones could be inserted in the circuit. The disadvantage of doing so is that, if 60 or 80 volts plate potential are employed, an unfair strain is placed on the insulation of the telephone windings.

Although there are losses in all transformers due to magnetic leakage the author is of opinion that for experimental work with the thermionic valve, a pair of L.R. telephones, say 60 ohms each earpiece, of good make, employed in conjunction with a properly designed transformer, is efficient and most economical for the experimenter.

The statement of the dealer, therefore, that " any old transformer will do," should not be accepted.

A very good combination is a pair of Brown's 60 ohms telephones and a " valve to telephone transformer " from a service C. Mark III amplifier. The excellent results obtained with this combination is largely due, I believe, to the fact that the impedances of the two components are of a similar value.

An experiment was made somewhat hurriedly by the writer and two independent observers, to ascertain to what degree signals would be reduced in strength. An ordinary crystal set was employed in the test. The comparison was made between a transformer with L.R. telephones and three pairs of H.R. telephones, switched separately in circuit. Observations were made with very weak signals and all listening failed to detect any appreciable difference in signal strength.

To return to the instrument under construction. The variable condenser should now be fixed in position by means of suitable screws, and if a condenser from a Mark III receiver is employed it is advisable to slightly raise it off the panel, so as to permit of any wiring as shown in pp. 680-681 being passed between it and the panel. Four ebonite washers, approximately ⅜ in. diameter × ⅛ in., will serve this purpose. The twelve terminals, two-way switch, coil plug for H.F. circuit, 0·0002 mfd. grid condenser and leak, 0·03 mfd. condenser, and all wiring should now be added, the four wires, *A*, *B*, *C*, *D*, being left until last. The particular lugs of the switch to which these four wires, *A*, *B*, *C*, *D*, should be soldered, may not be clear at first sight to some, and therefore the following method of procedure may prove helpful.

First, check the position of the switch in the panel. The correct position is as indicated in the full-sized diagram, viz., the four screws in the switch being visible, as shown. Fig. 6 is an end view of the Dewar switch, and for clearness the lugs are shown as circles. The end of the actual switch should now be compared, side by side with Fig. 6, and a mental note made that *D* and *B* are two of the longest springs in the switch.

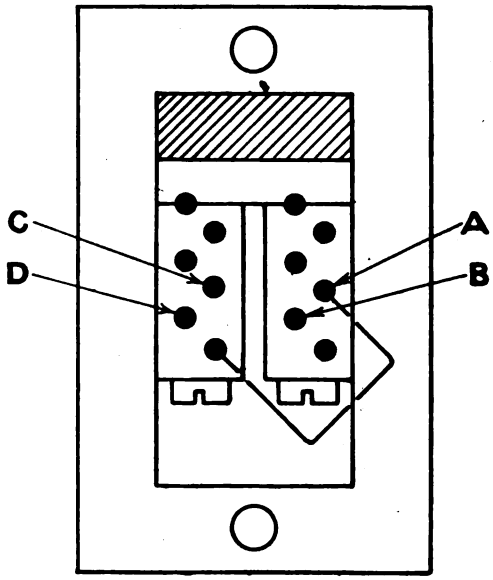


*Fig. 6. Enlarged end view of Dewar switch showing connections.*

The next step is, with the switch in the neutral position, to trace out on the instrument the path the wires *D*, *C*, are to follow.

The track is from H.T. + to primary of telephone transformer through the primary of the transformer to the lug *D* on the switch, thence through the tiny contact on *D* to lug *C*, and finally to the plate terminal of the third valve.

Follow the same method with wires *A*, *B*, and trace from H.T. + to primary inter-valve transformer, through the transformer to lug *B*, thence through the contact on *B* to lug *A*, thence to the reaction terminal thence through the strap bridging the two reaction terminals, and finally to the plate terminal of the detecting valve.

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These connections *A*, *B*, *C*, *D*, must be well spaced, and it is advisable to use comparatively stiff wire. One strand of No. 7/22 phosphor bronze aerial wire meets the purpose admirably, sleeving insulation being employed as in the case of all the other wiring.

With the exception of the coil holder, the instrument is now practically finished, and it is left to the constructor's good judgment to add those little details which will help to give a professional appearance to the instrument.

For those interested in building the instrument by three stages, Fig. 2b. p. 679 was prepared. This diagram shows the panel and *only* the wiring connections of a single valve. A few minutes' comparison between Figs. 2b and the full-sized diagram pp. 680 and 681 should enable the reader to realise that the H.F. valve can be added to the panel without disturbing to any appreciable extent the wiring seen in Fig. 2b.

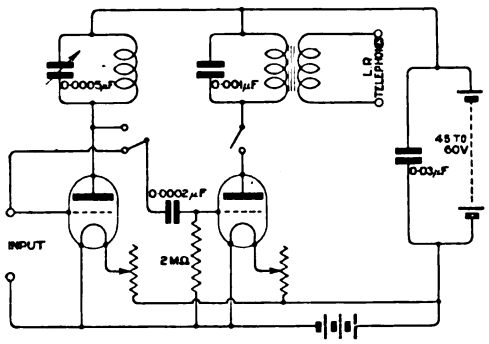


*Fig. 7. Circuit diagram with two valves.*

The only alterations are :—

The grid leak should be disconnected from the wire connected to terminal *A*, Fig. 2b, and transferred to terminal *E*.

The wire connecting terminal *A* to the grid condenser is to be disconnected at the condenser end, and joined to the grid of the H.F. valve.

The wiring of the H.F. circuit can then be proceeded with. This wiring should be traced and reasoned out from the full-sized diagram, pp. 680 and 681 and Figs. 7 and 2b. The following are the parts required to complete the high frequency valve circuit :—

1 Filament resistance.
1 Valve socket.
1 Two-way switch.
1 0·0005 mfd. variable condenser.
1 Standard plug as shown on panel in Fig. 1.
1 0·03 mfd. fixed condenser.

From the experience gained in the building of the first and second valve in the panel, there should be no difficulty in adding the remaining valve and circuit if the full-sized diagram is again referred to, this time in conjunction with Fig 3, p, 679, and due care is exercised with the wiring of the Dewar switch.

OPERATION OF THE SET.

Before passing to the operation of the instrument a few remarks are thought necessary with regard to the following :— Coilholder and coils, valve adaptor and the alternative use of a non-inductive resistance for the H.F. circuit.

In order that coils of the duo-lateral, Burndept, or similar types may be employed for the aerial and reaction circuit respectively, a coilholder must be provided. This is a device for supporting two or three coils, usually in a vertical plane, as can be seen in Fig. 1, p. 678, one coil being plugged to a stationary position, and the other pivoted, and capable of turning about a vertical axis through an angle of 90 degrees.

There are several designs of coil-holders advertised for sale ready for attaching to instruments. As, however, throughout this article it has been considered that the reader wishes to construct his set as cheaply as possible, with due regard to efficiency, the following suggestion is given for the construction of a coil-holder to accommodate two coils, with space for the addition of a third coil if required.

Two standard coil plugs, as shown in Figure 1, p. 678, should first be obtained, together with an ebonite rod about 6 ins. long by ½ in. in diameter, one ebonite knob, two small brass terminals, and a piece of brass rod, ¼ in. in diameter by 1¼ ins. long. Having obtained these, prepare a piece of planed hard wood, 4 ins. in diameter by ½ in. thick. By means of a tenon saw cut this into two semi-circular pieces, and if possible smooth the edges left rough by the saw.

Cut off a piece of the ebonite rod, 2½ ins. long, and place a pencil mark on the rod, 1¼ ins. from one end, or in other words, at the centre of the rod. At points 9/32 ins. on either side of this mark (in a direct line), bore holes through the rod, ⅛ in. diameter.

By means of two screws which are provided with the plug, screw the plug to the ebonite rod through holes just bored. A brass terminal should now be suitably cut down to form a pivot and screwed tightly into one end of the rod. This will increase the length of the rod

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by about $\frac{3}{8}$ of an inch, the exact increase depending upon the type of terminal chosen for the purpose.

To the other end of this rod, the ebonite knob and $\frac{1}{4}$ in. diameter brass rod are fastened.

A simple means of doing this is to bore a small hole, $\frac{1}{2}$ in. deep, in the end of the ebonite rod, and into this hole screw tightly the shank of a Mark III or similar terminal from which the nuts have first been removed and the total length of the terminal reduced to $1\frac{3}{8}$ in.

The remaining end of the terminal which originally carried a thumbscrew, is soldered into a hole bored to receive it in one end of the $\frac{1}{4}$ in. brass rod.

An easy means of fastening the knob to this brass rod is to drill a hole, 7/32 in. diameter full by $\frac{1}{4}$ in. deep in the knob, force the knob on, and secure in position by means of a 1/16 in. pin passing through the diameter of the knob and rod. The two semi-circular pieces of wood should now be bushed, the bottom one to receive the pivot and the top one to allow the $\frac{1}{4}$ in. rod to pass through it. Simple bushes can be made from 1/16 in. brass strip, measuring 1 in. by $\frac{1}{2}$ in., countersunk in the wood and held by wood screws.

The position of these and the rods carrying the plugs can be gathered by a consideration of the coil-holder shown in Fig. 1.

The stationary plug is secured to the remaining piece of ebonite rod by the same method as was adopted for the moving one, and fastened in a central position between the semi-circular pieces of wood by screws passing into its ends.

Having adjusted the length of this rod to suit the moving one, all that remains is to provide a backing piece of wood to fasten the semi-circular pieces to, and a $\frac{1}{4}$-in. spring washer, to be included with the moving rod, in order to prevent it moving too freely.

After the coil-holder has been screwed in position on the end of the instrument, wire connections are made from the screws of the stationary plug to the reaction terminals and from the moving plug to terminals *A* and *B*.

COILS.

In order that a large range of wavelengths may be covered, it is recommended that for compactness, coils of the duo-lateral or similar type should be employed for the H.F. and aerial circuits respectively. and purchased from firms who guarantee the inductance of each coil supplied.

Possessed of this information, the experimenter can calculate with certainty the range of wavelengths covered with each coil and known condenser.

For those who wish to experiment with basket coils the dimensions of the spider shown in Fig. 8 is given.

The centre is $\frac{7}{8}$ in. by $\frac{3}{8}$ in. thick, the spokes are $\frac{1}{8}$ in. diameter and eleven in number. The complete spider can be constructed of metal with threaded spokes, or the hub may be of ebonite and the spokes of tapered wood, simply pushed into holes drilled in the periphery of the hub.

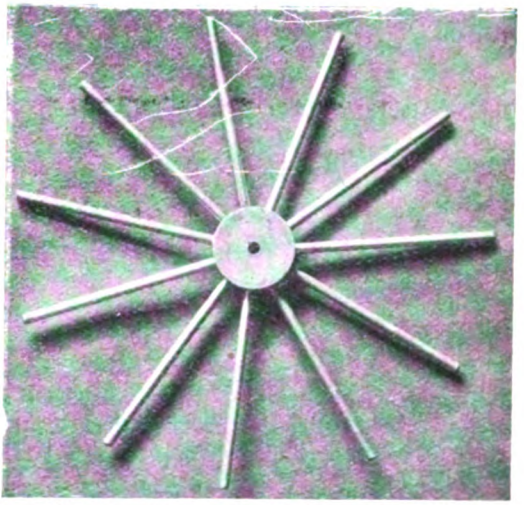

*Fig.* 8. *Former for basket coil winding.*

Obviously, if the dimensions of these coils are to be kept within reasonable limits, a wire of small cross sectional area must be employed. The disadvantage of employing a small wire however, is its resistance to high-frequency currents, for, as its diameter decreases, its resistance increases, resulting in damping and loss in signal strength. It is suggested, therefore, that the basket coils should be wound with No. 36 D.S.C. copper wire.

Using this gauge wire, and the above former, a coil wound to a diameter of $2\frac{7}{8}$ in. for use in the H.F. circuit, employed in conjunction with the 0·0005 mfd. condenser functioning near its minimum value, gives a wavelength of 1,050 metres approximately. If, however, this coil is tapped at points 1 in., $1\frac{1}{4}$ in. and $1\frac{3}{8}$ in. radius, wavelengths to the value of 350, 450 and 600 metres respectively are covered.

These values are also obtained with the

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condenser functioning near its minimum value.

However, it is reiterated that the purchase of coils is recommended.

VALVES AND VALVE ADAPTOR.

Suitable valves for use with the instrument are :—

A good French or V.24 for H.F.
A good French or V.24 for L.F.
A Qx, Q or captured German valve with cylindrical anode (shown in the photograph) for detecting.

For those who may have purchased captured German valves from the Disposal Board, the valve adaptor shown in Fig. 9 will be found useful.

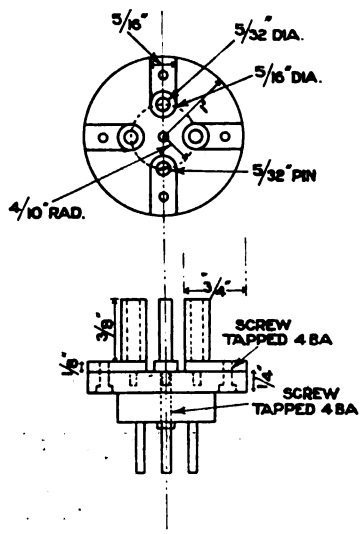


*Fig. 9. Details of the adapter for German type valve.*

It is mentioned that the lower part of the adaptor is part of a broken French valve, otherwise the drawing is self-explanatory.

THE ALTERNATIVE USE OF A NON-INDUCTIVE RESISTANCE FOR THE H.F. CIRCUIT.

Experimenters who wish to avoid the trouble of tuning the anode circuit of the H.F. valve for wavelengths greater than 1,200 metres, should suitably mount a resistance rod of 0·05 megohms resistance and plug this in, in place of the coil.

This, however, will necessitate the disconnection of the 0·0005 mfds. condenser, which would otherwise shunt the resistance. With the introduction of this resistance, the H.T. voltage must be raised to allow for the voltage drop across the resistance.

For example: Supposing that with the tuned anode circuit, a French valve is employed with 25 volts H.T., the valve functioning about the centre of its characteristic with zero grid potential and 0·7 milliampere flowing in plate circuit.

Now, in order to ensure that the valve shall function on its selected characteristic after the tuned anode circuit has been replaced by a resistance of the value mentioned, the plate voltage must be increased to 60 volts, owing to the fact that 35 volts is dropped across the resistance, viz., $C = 0{\cdot}7\ mA$, $R = 50{,}000$ ohms, $E = CR$.

Therefore $0{\cdot}7 \times 10^{-3} \times 50{,}000 = 35$ volts.

It is evident then, that this 35 volts must be added to the 25 volts which is required to force through the filament anode path the current of 0·7 *mA*.

RECEPTION.

As it is the ambition of many experimenters to receive the Dutch concert, a few hints as to the adjustment of the instrument for that purpose may be useful.

The aerial is connected to terminal *A*, and the earth wire in series with a variable condenser to terminal *E*. Suitable inductances are plugged in the coil-holder, their values depending upon dimensions of the aerial in use.

For the H.F. circuit, Burndept Coil No. 200 is recommended, if 0·0005 mfd. condenser is employed.

After the batteries and other necessary components have been connected, the switch on the front of the instrument is placed to neutral, the "two-way" switch turned to the left, and the strap bridging the reactance terminals opened. Proceed to switch the three filaments on (the H.F. valve not too brightly at first).

With the moving coil set at an angle of 45 degrees, rotate the A.T.C. and H.F. condenser simultaneously until the music is picked up. The filament current of the H.F. valve should then be gradually increased and coupling etc., adjusted for maximum signals, taking particular care that the set does not oscillate. If desired, and in order to reduce number of adjustments, the reaction coil can be shorted and the set brought to it most sensitive point (viz., just on verge of oscillation) by gradually brightening filament of the H.F. valve.

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As a matter of interest to readers, it may be mentioned that the concert was received well in London on August 6th with the instrument described and a very poor aerial. There were three pairs of telephones in circuit. It was also quite good with two valves and the same number of telephones in use.

For the transition to the "two-valve" position, viz., one H.F. and one detecting, the Dewar switch is turned to upward position (opposite to the position shown in photograph) and the L.F. valve filament switched off. This last movement being optional.

It may be pointed out that the vacant terminals or lugs of the Dewar switch can be utilised for other switching combinations. For instance, for reversing the reaction leads, etc., etc.; however, for the sake of wiring simplicity such refinements have been purposely omitted.

If now only one valve is required, viz., the detecting one, the Dewar switch is turned upwards, the two-way switch to the right, and the leads to the reaction terminals reversed.

If it is desired to add the L.F. valve behind this one the Dewar switch is replaced to neutral position and last valve filament switched on.

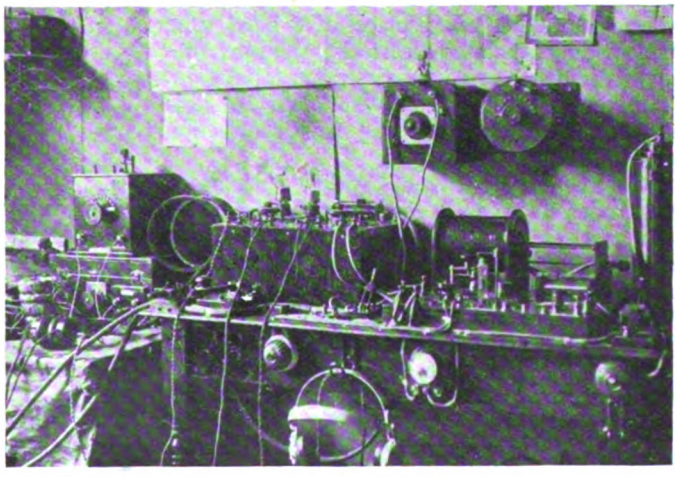
In conclusion, the writer hopes that he has not been over explanatory and trusts that this article may be of use, especially to those amateurs who make use of the "Questions and Answers" column of this journal.

# An Experimental Wireless Station

By G. W. MORTIMER.

THE accompanying photograph shows my wireless station at 1, King Street, Yeovil. As it might interest other amateurs I give a short description as follows :—

At the right of photograph is a single valve set with loose coupler, using V24 or "R" valves and also arranged for crystal reception should the accumulators fail at any time. In the centre of photograph can be seen the set I have just completed, using two valves and honeycomb coils for tuning. This set is extremely good, and signals are sometimes too loud to keep the telephones on your head. It is arranged to use either two V 24 or "R" valves. Those seen in photo are one French "R" and Ediswan EC2, this combination giving good results. The two large coils shown on the set are specials for the Dutch concert, etc., the usual coils, eight in number, are seen at the extreme left of photograph in front of the H.T. battery box. On the top of the battery box is a short wave crystal set on which I get ships, etc. All the apparatus is of my own construction with the exception of telephones, which are Brown's 4,000 ohms, I can get all the usual stations, telephony. etc., quite loud.



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# A New Rectifier

By V. BUSH and C. G. SMITH.

*The following abstract of a paper presented to the Institute of Radio Engineers, New York, describes an entirely new form of rectifier with cold electrodes. The tube is developed from the phenomenom that in order to produce ionisation there must be sufficient space between electrodes to allow collision to take place. If the electrodes are arranged close together, collision may still take place if the mean free path is extended by the application of a magnetic field.*

THE purpose of this paper is to introduce a new form of rectifier. Briefly described, it consists of a pair of electrodes surrounded by a moderate pressure of gas, the conduction between the electrodes being definitely under the control of a magnetic field. The electrodes may both be cold, as thermionic emission is not utilised. The device has no definite current limit, except such as is imposed by the heating due to losses. It is adapted for high voltage purposes and has a very long life.

Only one of the simplest forms of these tubes will be described and its theory developed, for a complete analysis is very involved. However, such theory as is here presented can be quite accurately checked with such a tube of the type to which it strictly applies.

Gaseous conduction between electrodes in a gas at low pressure is usually considered an erratic and unreliable phenomenon. When such conduction takes place in a glass tube with widely separated electrodes, the phenomenon decidely earns its undesirable reputation. The problem in the development of this rectifier has been to bring this conduction under control.

Conduction between widely separated electrodes in a gas at low pressure, assuming that the electrodes remain sufficiently cold to bar effects due to the thermionic emission or vaporisation of the metal, takes place by reason of ionisation by collision. In a gas there is always a certain small amount of spontaneous ionisation and under a potential gradient of sufficient magnitude, the number of ions rapidly increases, for the speed attained by the freed electrons becomes sufficient, so that upon impact with neutral molecules they knock them apart, producing ions and more electrons. The process is thus cumulative until sufficient current flows to reduce the potential between the electrodes to a definite value, depending upon many factors.

In order to produce gaseous conduction proper, therefore, two factors are necessary; first, a potential gradient sufficient to produce ionisation, and second, sufficient distance between electrodes for collision to take place.

If two electrodes are so situated in a gas that they are nowhere separated by a length of discharge path of the order of magnitude of the mean free path of an electron in the gas used, and at the pressure present, and if there is no magnetic field present, then there can be no gaseous conduction proper between such electrodes at any potential difference whatsoever. Ionisation by collision cannot become cumulative, for in the great majority of cases a spontaneously freed electron drops into the anode without impacting with a neutral molecule. The space between the electrodes is thus kept clear of free electrons and ions.

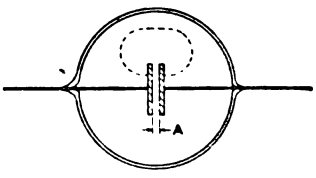


*Fig.* 1.

The conduction which takes place due to the spontaneous formation of ions is extremely minute, and is the same sort of conduction as takes place between electrodes in air at atmospheric pressure and at potentials below the point of corona formation, which conduction can only be detected with difficulty.

It is, in fact, sufficient to prevent conduction that all lines of electrostatic stress between the electrodes be either short compared to the mean free path of the electron, or else be interrupted by an isolated body capable of accumulating a charge. Very many forms of electrodes may be constructed to utilise this principle, one or two of which will be illustrated in this paper.

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The tube of Fig. 1 will conduct at a comparatively low potential if filled with, say, hydrogen to a pressure of 0.1 mm., even although the distance of separation A be much less than the mean free path of an electron in hydrogen at this pressure. The conduction will take place along paths such as the one shown dotted.

*Fig.* 2.

However, a tube such as shown in Fig. 2 will not so conduct; for the only long lines along which an electron may be propelled by the potential difference are interrupted by the glass walls, which will accumulate a charge and reduce the gradient in the gas to a low value.

Such a tube, constructed with properly cleaned electrodes, will not pass a microampere at a potential difference of ten thousand volts. Of course at very high potential gradients, of the order of magnitude of a million volts to the inch or so, very peculiar effects may be produced; but not gaseous conduction proper.

A tube which insulates by reason of the short path principle may be rendered conducting by the introduction of a magnetic field of proper value, and in direction perpendicular to the lines of electrostatic stress.

When an electron, moving in the short distance between two electrodes, is acted upon by a magnetic field, its path is curved and thereby lengthened. Moreover, the increase in length of path of an electron starting from the cathode is gradual, with increasing magnetic field strength up to a certain value, and after that it becomes very sudden. This sudden increase occurs when the path curvature is such that the electron completely misses the opposite electrode. The electron paths between plane electrodes for various field strengths are plotted in Fig. 3 to render this clear.

The magnetic field strength necessary just to make the electron thus miss the opposite electrode can be calculated. Its value depends upon the potential $E$ between electrodes, their separation $a$, and the electron ratio of charges to mass $m$, thus.

$$H = \frac{1}{A}\sqrt{\frac{2Em}{e}} \quad . \quad . \quad . \quad . \quad (1)$$

or, if $E$ is in volts, and $a$ in centimetres, we may insert the value of $e/m$ and write:

$$H = \frac{3{\cdot}35\sqrt{E}}{A} \text{ gauss} \quad . \quad . \quad . \quad (2)$$

for the critical field strength.

Let us now construct a tube such that the distance straight between electrodes is too short to ionise, but such that the path of an electron is just made to miss the opposite electrode sufficiently long to ionise. Assume a high potential in accordance with the short path principle Apply a magnetic field to this tube parallel to the electrode surface. Then when this field is increased to the critical value, the tube will very suddenly conduct freely. The electrons fly in long paths and ionise by impact. The positive ions thus formed drop into the cathode and produce secondary emission of electrons from the surface. The new electrons also pursue long paths and ionise in turn. Since one ion may knock several electrons from the cathode, and each electron may make several ions, the process is cumulative; and the discharge builds up to a point determined by the external circuit.

It may be noted in passing that the critical nature of this phenomenon gives a simple method by which the value of $e/m$ may be checked experimentally.

A rectifier may now be constructed. Construct a short path tube and place it in one of the usual rectifier circuits Apply to the tube an alternating field and a uni-directional field superposed. Adjust the field such that during one half cycle it is correct for conduction, and during the next half wave, not. The tube will then rectify completely.

This, however, is not the simplest construction. By using curved electrodes instead of

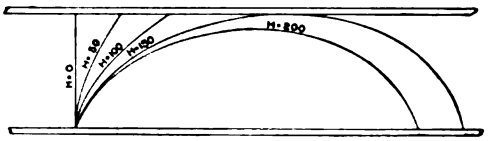


*Fig.* 3.

plane electrodes, a permanent magnet may be used to supply a uni-directional field, and the alternating field dispensed with.

If concentric cylinders are used for electrodes and suitable arrangements made to render the end paths also short, an axial field of proper strength will render the tube conducting. However, it may be shown, that the critical field strength is now different



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for conduction in the two directions. In fact the critical field strengths bear the same ratio as the diameters of the cylinders, that is :

$$\frac{Hh}{Hg} = \frac{g}{h} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Thus for conduction with the outer cylinder negative, the critical magnetic field is smaller than when the inner is negative.

*Fig.* 4.

A tube arranged with cylindrical electrodes and supplied with a permanent axial field, intermediate between these two critical values, will then conduct in one direction but not in the other. This gives a very simple rectifier indeed.

By suitable choice of diameters and field strength, the tube may be so arranged that it conducts in one direction as soon as the potential across the tube rises to a value sufficient to give ionisation by collision and secondary emission, that is to one or two hundred volts depending upon the gas and electrode material used. It may also be arranged so that when the potential in the opposite direction rises to this same value the field will be already too weak for conduction. The tube will not then conduct in the wrong direction for any value of voltage up to that which destroys the insulation or otherwise allows the tube to flash over.

Certain other benefits may be obtained by the use of non-uniform fields; but the consideration of these effects will be reserved for later treatment.

Another model of the tube is shown in Fig. 4, and in Fig. 5 it is shown supplied with a permanent magnet and pole pieces for producing the axial field. A section of this design is also shown in Fig. 6

The inert, monatomic gases are preferable for filling these tubes, because of their lack of chemical action and low potential drop. Using helium and aluminium electrodes, the drop in the tube is in the neighbourhood of 150 volts. Under these conditions the disintegration of the electrodes is very slight when operating normally.

Since the cooling of the electrodes occurs largely by reason of the heat conductivity of the working gas, it is unnecessary to run the electrodes very hot in order to dissipate a considerable amount of loss. A tube 7 ins. (17·8 cm.) long, of the type illustrated above, will handle 230 milliamperes continuously with the electrodes well below a red heat. There will then be about 40 watts loss in the tube.

The output depends, of course, on the voltage being rectified. At 4,000 volts a current of 250 milliamperes represents an output of 1 kilowatt. Several amperes may be passed through such a tube for a short interval.

The voltage current characteristic of a tube depends largely upon its design. With the arrangement shown above, the voltage drop will rise about 10 per cent. from no load to full load.

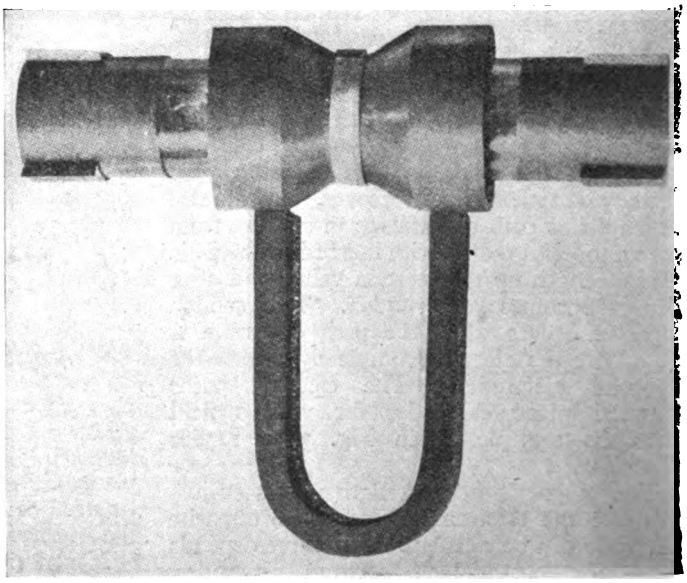

*Fig.* 5.

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The wave form of potential delivered by a rectifier depends, of course, upon the circuit in which it is used. The "S" tube is a complete rectifier, as no appreciable current passes in the reverse direction. A practically constant drop of 150 to 200 volts is inherent in this particular design. By using polyphase connections, or condenser and inductance combinations, the ripple in the delivered voltage may be reduced.

As a rugged, long-lived, relatively inexpensive rectifier there will probably be many uses to which this tube can be put. In particular, it should serve as a convenient source of direct current for use in thermionic valve transmitters, particularly for high powers. It should make also a convenient piece of laboratory apparatus.

This paper is necessarily limited in its treatment to merely an introduction of the device. The authors will very much welcome any suggestions as to ways in which it will be possible to make this new instrument of greatest service to the practice of radio telegraphy and telephony.

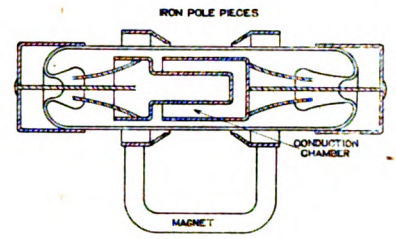


*Fig.* 6.

# A Microphone Amplifier

THE instrument illustrated in Fig. 1, which is now on the market, is deserving of special attention. It is a new type of microphone amplifier, which is particularly suitable for use where it is desired to amplify speech or music before conveying it to a loud speaker. The instrument has the special feature of giving very great amplification without any serious distortion.

The instrument is operated with a 6-volt battery of dry cells, and the only other terminals are those for connecting direct from the output terminals of the wireless receiver and those provided for connecting a loud speaker of 120 ohms resistance. A diagram of the internal wiring of the amplifier is given in Fig. 2.

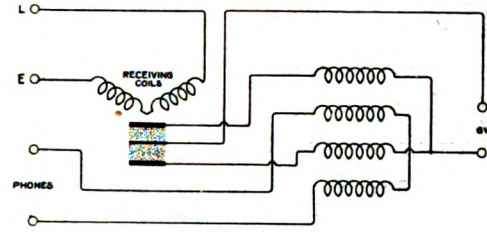


*Fig.* 2.

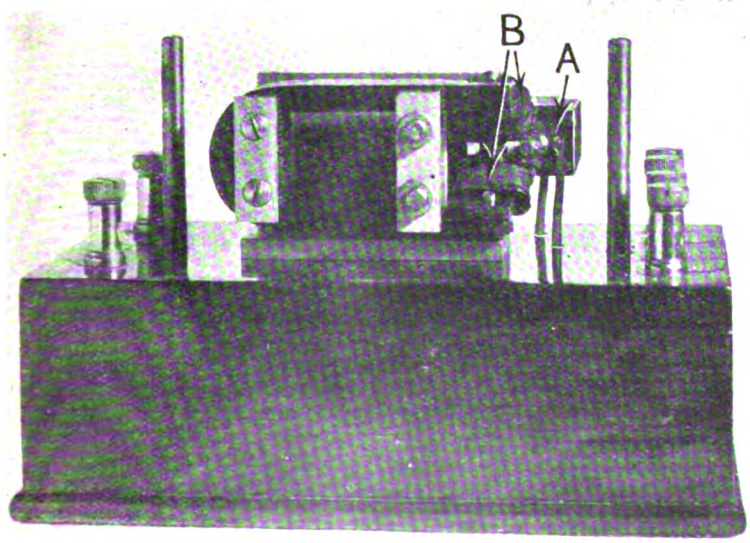


*Fig.* 1.

The microphone amplifier consists of a differential microphone connected to a reed, which is operated by an electro-magnet. The magnet is adjustable, so that its position can be varied in order to bring it as near as possible to the reed without actually touching.

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# The Equipment of 2 PV.

By G. SMITH CLARKE.

THIS station is of home construction, and may be described as a "universal" station as far as the wavelength range of the receiver is concerned.

RECEIVER.

In the receiving apparatus one to six valves may be used without the employment of any switches. There are three stages of high frequency amplification, using either transformer, resistance capacity, or reactance capacity coupling, easily interchangable. Next comes the detector valve, followed by two stages of low frequency amplification brought into circuit by means of jacks and plugs.

Condensers for transformer tuning may be plugged in across either primary or secondary.

Long wave tuning is done on home-made honeycomb coils available up to 30,000 metres. Short wave coils up to 500 metres are single layer *Litz* wound.

A switch is provided which gives either loose or direct coupling to the aerial, and a reversing switch is employed for reversing the direction of the reaction coil though reaction is seldom employed when H.F. amplification is used.

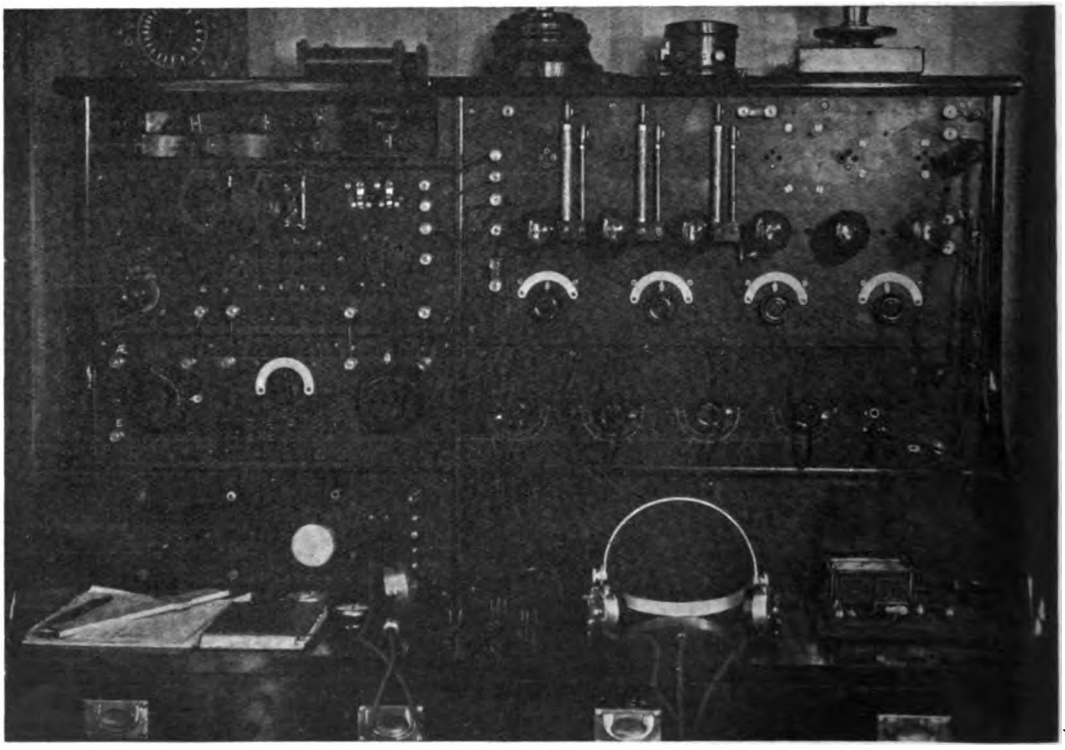
The aerial tuning condenser is of 0·0011 mfds. capacity, and the closed circuit condenser 0·00055 mfds. with a vernier 0·000001 in parallel. The condensers are Sullivan type.

THE TRANSMITTER.

The transmitter is built on the lines of the R.A.F. choke control set. It is licensed for use with artificial aerial only at present.

The circuits in use have been accurately calibrated.

All English and European stations can be read without the use of "phones," the Western Electric loud speaker (rewound to 120 ohms), working directly off the phone transformer. Several American stations can be



*Station* 2 PV, *Kenilworth.*

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read with phones on table. FL comes in with aerial cut off.

Telephony is very loud and clear; on six valves FL concerts and weather reports can be heard in the garden. The Dutch concert can be clearly heard 100 yards from the loud speaker, that is, just about as loud as Croydon, but much clearer. I have received telephony from the following amateur stations: 2 AW, 2 QU, 2 OQ, 2 HF, 2 KD, 2 IQ, 2 NA, 2 LG, 2 KQ, 2 SP (or B), 2 NC, 2 DL, 2 ML, 2 KO, 2 ND, 2 FH and 2 UY.

**2 PV.** *Showing H.F. Intervalve Transformer in position.*

**2 MT** was very good on 700 metres, but is subject to a great deal of interference on 400 metres. Amateurs on 440 metres are coming in very strongly, while Marconi House on 360 metres is very nearly perfect in all respects.

Ever increasing numbers of "howling" sets are a great nuisance, and I think that at present this is the greatest problem in amateur radio, and one which should receive the earnest attention of every wireless society.

After much trouble with dry cells, I am now using Siemen's H.T.3 Leclanche batteries for high tension supply. These are excellent, and during the six months they have been in use have given no trouble of any sort. I shall never go back to dry cells.

# Notes

### A Visit from America.

Mr. Milton B. Sleeper, whose name is so well known in this country, as well as in the United States, has recently paid a short visit to England.

There is no doubt that Mr. Sleeper was much impressed with the quality and finish of wireless apparatus of British manufacture, and he expressed regret at being unable to extend his visit to the provinces owing to lack of time. Mr. Sleeper is a keen advocate of closer association between British and American amateurs, and we may be sure that on his part he will do all that is possible to bring this about.

### Mr. Leon Deloy in London.

Mr. Leon Deloy, of 8 AB, Nice, is visiting this country. His programme includes a number of calls on personalities in the world of amateur wireless, even so far afield as Aberdeenshire, where he is visiting Mr. Spence. We understand that after leaving England Mr. Deloy will go to Holland for the purpose of inspecting PCGG. We have had the pleasure of meeting Mr. Deloy in the company of Mr. W. J. Crampton.

### Radio Telephone Range Tests.

The United States Bureau of Standards is planning to conduct comprehensive tests to determine the effective working ranges of radio telephone communication when using various kinds of transmitting and receiving sets. Preliminary plans have been outlined for this work, and some correspondence conducted in regard to it.

### Dutch Concerts.

In view of the fact that changes in the wavelengths, etc., of the *Daily Mail* concerts from the Hague are anticipated, details are omitted from our calendar this week; though it is understood that there will be no interruption of these concerts.

### Competition at the Concours Lepine.

Competitions of Industrial inventions are held annually at the Concours Lépine which was founded by the late Prefect of the Seine in 1901. This year wireless will form the subject of one of the competitions. Exhibitions will be held on the Champ de Mars from August 25th to October 2nd, of all kinds of wireless receiving apparatus and of processes of manufacture. Experts are to lecture on wireless subjects.

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*Berne Wireless Station. The "Leading-in" Insulators for Aerial and Earth Screen and Ordinary Ground Earth.*

**New American Direction Finding Stations.**

Nine American companies interested in the manufacture of radio direction finders met at the Bureau of Standards to confer with the Assistant Secretary of Commerce, the Bureau of Lighthouses, and the Bureau of Standards, regarding the production, cost, installation, calibration, and maintenance of radio direction finders on ships.

It was announced that the Department of Commerce has decided to install the following stations for the purpose of direction finding: Boston, Nantucket, Cape Charles, Columbia River, Puget Sound, and, if funds are still available, Delaware Bay, Los Angeles, and Blunt's Reef. These are in addition to the two new stations at Diamond Shoal (off Cape Hatteras) and San Francisco Light Vessel. Three other stations have been in operation in the vicinity of New York Harbour for over a year at Ambrose, Fire Island and Sea Girt.

As a result of the conference, arrangements will be made through the Bureau of Lighthouses, between the manufacturers of radio direction finders and the operators of steamships for the trial and demonstration of direction finding equipment produced by the several manufacturers under conditions of practice.

**Eiffel Tower Weather Warnings.**

When the weather reports are received by the Eiffel Tower the forecast is issued locally by bell. Three strokes announce rain, six frost, ten storm or hail. Meteorological reports are issued by wireless telephone daily, at the following hours, 0450, 1215, 1810. The wavelength used is 2,600 metres.

**Shipping Conference Report on Wireless at Sea**

At the International Shipping Conference three Committees were appointed one of which was to examine the question of life-saving appliances and wireless telegraphy. The reports of these Committees are now issued.

With regard to wireless, it was decided to recommend amendments for the purpose of allowing partial as well as total exemption for coasting and short sea trade vessels, and for permitting of the installation of an automatic calling apparatus under prescribed tests as to efficiency. With regard to the choice of navigational instruments for directional wireless, the Committee think that shipowners may, without risk, be left to choose their own time and method for its adoption, and that the fewer Government regulations that are applied to it the more satisfactory will be its development.

## Book Received

TECHNICAL ELECTRICITY. By H. T. Davidge, B.Sc., M.I.E.E., and Robert W. Wutchinson, M.Sc., A.M.I.E.E. (London: *W. B. Clive, University Tutorial Press, Ltd., High Street, New Oxford Street, W.C.* Pp. 514. 8§" × 6". 10s. 6d.)

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### Wireless Class Formed at Huddersfield.

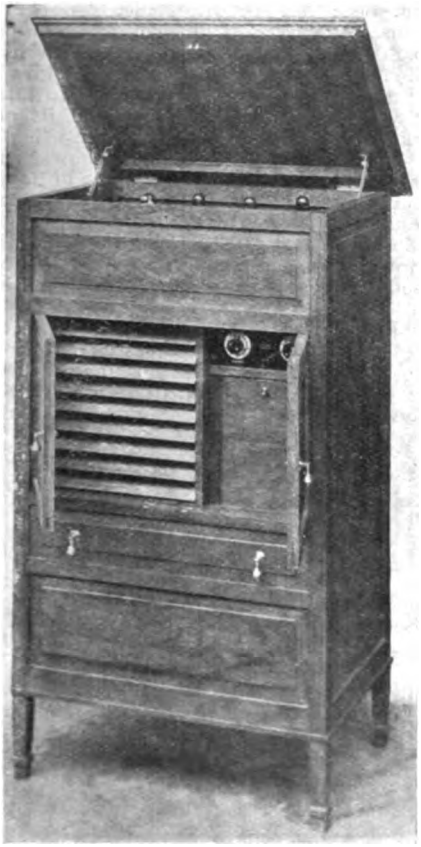
Wireless telegraphy and telephony are to be taught at a special class to be formed at the Huddersfield Technical College providing a minimum of fifteen students agree to attend. Such is the decision of the Education Committee of that town.

### Cost of Swedish Station.

A Stockholm report says that the wireless station which the Radio Corporation of America will erect on the West Coast of Sweden is to cost 3,700,000 crowns. It is expected that the station will be completed next year.

### French Army Grand Manœuvres.

Experiments are to be conducted in wireless telegraphy and telephony in conjunction with the grand manœuvres of the French Army, which will take place between September 10th and 18th.

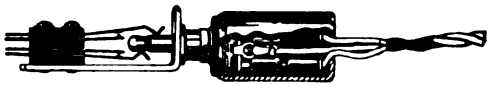


### A Broadcast Receiver de Luxe.

The accompanying photograph is of a Broadcast Receiver which is being manufactured by Marconi's Wireless Telegraph Company, Ltd. As can be seen from the illustration, the valves and other apparatus are contained in the top where the turntable of a cabinet gramaphone, which the instrument resembles, would ordinarily be located.

### Useful Wireless Plugs and Jacks.

The accompanying illustration shows a very useful design of plug to be used in conjunction with jacks of a type of which a number of different designs are marketed.



The use of plugs and jacks gives a very neat appearance to a finished set, and this particular type requires only one hole for fixing in the panel. All sorts of switching can be condensed into small space, and plugs and jacks may be used for such purposes as switching in filament, connecting across different valves, disconnected intervalve transformers at the point of insertion, etc. The jacks illustrated have nickel silver springs with sterling silver contacts, and the plugs, which are soundly constructed, have a special type of grip for taking the flexible leads.

### New Companies

Among the new private companies which have just been registered are the following:—Messrs. G. F. Sugden & Co., Ltd., capital £5,000 in £1 shares, electrical engineers, telegraphy, telephony, radio-telegraphy and radio-telephony engineers, etc. Secretary, Mr. G. F. Sugden, 9, Albert Square, Manchester. Scottish Wireless Telephone Supplies, Ltd., capital £1,500 in £1 shares, to manufacture buy and sell apparatus appertaining to wireless installations (telephone or telegraphic), etc. Registered office, 82, Crown Street, Aberdeen. South Wales Wireless Installation Co., Ltd., capital £2,000 in £1 shares. To carry on business as indicated by the title. Secretary, Mr. W. H. Liles, 18, West Bute Street, Cardiff.

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# Calendar of Current Events

**Saturday, September 2nd.**

CROYDON WIRELESS AND PHYSICAL SOCIETY. Meeting.

**Monday, September 4th.**

ILKLEY AND DISTRICT WIRELESS SOCIETY. 8 *p.m.*—At Regent Café, Cowpasture Road, Ilkley, Morse Practice.

**Tuesday, September 5th.**

Transmission of Telephony at 8 *p.m.*, on 400 metres, by 2 MT, Writtle, near Chelmsford.

**Friday, September 8th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—Lecture on "Automatic Telephony," by Mr. H. Mortimer.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.
8 *p.m.*—At Erith Technical Institute, General Meeting and enrolment of members.

*Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.*—ED.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

## The Wireless Society of Hull and District.*

Hon. Secretary, 16, Portobello Street, Hull.

On August 14th, Mr. J. Nicholson gave a most instructive lecture on "Accumulators, their Use and Abuse." The chair was occupied by Mr. Hy. Strong, Acting Vice-President, and there was a fairly good number of members present. At the outset the lecturer apologised for not being in a position to impart some information on the subject that he had specially wished to obtain, that is with regard to the process of the manufacture of the plates, etc., but he hoped to do so in the future. After speaking about the various component parts of a modern type of accumulator, he then dwelt at some length upon the treatment which this article should be given if one wished to obtain the best out of it. He related a number of cases in which accumulators had been completely ruined by the first charge and emphasised the fact very strongly to all present that it is the first charge given to this article which determines its future usefulness. Mr. Nicholson knows his subject well as he daily comes in contact with all classes of this work.

The lecture proved very instructive to all present, and a number of members joined in the discussion which followed.

Mr. Nicholson was accorded a vote of thanks for his lecture.

Several new members were elected, including the first lady. They were accorded a hearty welcome.

Meetings of the Society are now held on the second Monday and the fourth Friday in each month, at the Signal Corps Headquarters in Park Street, where intending members will be welcomed.

## Radio Experimental Association (Nottingham and District).*

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A monthly general meeting of the above Association was held on July 27th, in Room 74, Mechanics' Institute, Nottingham.

Mr. Carpenter had consented to lecture during the evening, and very kindly continued his lecture on "Wireless during the War," dealing this time, however, with C.W. work only. From the drawings and diagrams which Mr. Carpenter presented, it was evident that he had spent considerable time in compiling same, and the lecture was most interesting and instructive. The lecturer clearly explained the functioning of each component part of the C.W. sets used chiefly in France during the war.

Mr. Carpenter also exhibited a German transmitting and receiving set combined, and explained details of construction which were very interesting.

At the close of the meeting Mr. Thornton proposed a hearty vote of thanks to the lecturer, in which all heartily concurred.

The next meeting will be held in Room 74, Mechanics' Institute, Nottingham, at 7.30 p.m. on Thursday, August 31st.

Any persons in the Nottingham district who are interested in Radio-telegraphy and telephony, and are not yet members, will receive full particulars on application to the Hon. Secretary.

## Wireless Society of Highgate.*

Hon. Sec: Mr. D. H. Eade, "Gatra" 13a, Sedgemere Avenue, East Finchley, N.2.

On Fridays, July 21st and August 4th, Mr. J. F Stanley, B.Sc., gave the fifth and sixth of his series of lectures on the theory of wireless. In these he dealt very fully with the valve and its action, outlining the electron theory and then going on to deal with characteristic curves. He showed how by operating the valve on various points of its curve, rectification or amplification could be obtained. After going thoroughly over this ground, Mr. Stanley explained and contrasted amplification at high and low frequencies, and finally described the special methods of reception necessary to receive continuous wave signals.

On July 28th, Mr. F. L. Hogg gave the second of his lectures on the construction of wireless apparatus. He dealt with the various methods by which a one-valve set could be increased to form a multi-valve set, and described fully the various types of high and low frequency amplifiers.

Membership of the Society is still increasing and there are now over 50 members. Meetings are still being held regularly each Friday evening at the Highgate Literary and Scientific Institution, South Grove, Highgate, N., and will continue throughout the summer; and as soon as the holiday season is over the autumn programme will be arranged, and should prove of considerable assistance to members, especially those who are comparatively beginners in the subject.

The Honorary Secretary will be pleased to receive enquiries regarding membership, or will be pleased to see intending members at the Institution on Friday evenings between 7 and 9.30 p.m.

## Stoke on Trent Wireless and Experimental Society.*

Hon. Sec. Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of this society on Thursday, August 17th, Mr. R. W. Steel (Asst. Hon. Sec.) was appointed as third member of the Technical Committee. It was decided to appoint another member on the Working Committee, and as there is a fairly large Students' section, to have a Students' representative on the Committee. Mr. Schofield was accordingly elected as the Students' representative.

A resolution was passed to co-operate with the

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Y.M.C.A. and assist them in every possible way on the occasion of a lecture and demonstration on Wireless which they propose to hold in November. The Society also proposes to hold an Exhibition and Demonstration late this year, or early in the new year.

Arrangements are to be entered into to secure the services of lecturers from several Wireless Societies during the coming season.

Several members complained of the interference caused by some local amateurs, who when listening-in to wireless concerts, cause their sets to "oscillate" and so interfere with the reception of the concerts by other amateurs in the district. It was thought that these amateurs were doing a great deal of harm to amateurs in general, and, if the practice continued the Postmaster-General would prohibit the use of regenerative circuits altogether. This needless annoyance was, no doubt, not caused purposely, but was due to the ignorance of the owners, for while a set is oscillating it is impossible to receive properly. If these unwitting defaulters consulted their friends who had wireless receiving sets and knew how to use them, or joined a wireless society, they would soon learn how to avoid this trouble, with satisfaction to themselves, and to those with whom they were interfering. It was suggested that, with the aid of direction finding apparatus, to locate these offenders and to warn them of the nuisance they were causing, and if the practice continued after that, to report them to the Postmaster-General. It was decided to send an official protest to the Wireless Society of London.

It was much regretted that up to the present the necessary permission to proceed with the erection of the aerial had not been received. It is hoped that this will be remedied in the near future

The meeting closed after a little buzzer practice.

### Stockton and District Amateur Wireless Society.

Hon. Secretary, Mr. W. F. Wood.

The usual monthly meeting was held in the Concert Hall in the Malleable Workmen's Institute, Stockton, on Thursday, August 10th, under the presidency of Mr. J. Mulcaster, supported by Mr. S. G. Marston, Vice-President, and members of the Committee. After the usual business had been transacted the President distributed the prizes given by members of the Society for the most expert readers of the Morse code, open to members under the age of eighteen years, and which were deservedly won by Mr. R. Burnand and Mr. J. E. Laven.

The rest of the evening was taken up by a lecture given by Mr. W. B. Ward (of the Middlesbrough Wireless Society) on "High Frequency," which was illustrated by apparatus kindly brought specially by the lecturer for this meeting.

A vote of thanks was proposed by Mr. Mulcaster and seconded by Councillor Elliott which was enthusiastically endorsed by the many members present.

### The Beckenham and District Radio Society

Secretary: Mr. J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

The above Society is now in full swing. Although such a short time has elapsed since the inaugural meeting over thirty members have been enrolled, and many applications for membership are being received. At a general meeting held on Thursday, August 17th, it was decided to hold the meetings at 114, High Street, Beckenham (at the side of the "Dorothy" Tea Rooms), on Thursday evenings at 8.15 p.m.

A Committee was appointed to draw up Rules and also to arrange a syllabus of Lectures and Demonstrations.

On Saturday, August 19th, the Society gave a very successful demonstration at the Annual Fete of the Beckenham Allotment Society held at the Technical Institute, when by Special Permission of the P.M.G. Lieut Walker (2 OM), Brentford, kindly transmitted music at various intervals which were received perfectly and with marked satisfaction by a very large number of "listeners-in" of all ages.

This Society bids fair to be very popular in the district, many applications for membership being received at this demonstration. A junior section has been formed for those under the age of 18. Ladies are also welcomed as members.

All applications for membership should be addressed to the Hon. Sec.

### Barnoldswick Wireless and Technical Society.

Hon. Sec. Mr. J. Balderston, 6, Clough Terrace, Barnoldswick.

A meeting of the above Society was held on August 16th at the Gladstone Liberal Club. At the termination of the usual 30 minutes buzzer practice, a Lecture was given by Mr. A. G. Petty, B.Sc., entitled "Magnetism."

The lecture was delivered to a very enthusiastic audience, and was augmented throughout by very interesting and highly instructive experiments. The members are exhibiting a keen appetite for technical knowledge. Rapid progress is anticipated, and thanks to the fact that several of the members are skilled in scientific matters, the provision of suitable lectures does nor present any difficulty.

The Secretary solicits applications for membership from any gentlemen in the locality.

### Bridlington and District Wireless Society.

Hon Sec. Mr. M. Horspool, Darley, Marton Road, Bridlington.

The first meeting takes place at the Liberal Club, Quay Road, Bridlington, at 8 p.m., on Thursday, August 31st. All who are interested are invited to attend.

### Fulham and Chelsea Amateur Radio and Social Society.

Secretary, Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W. 6.

A meeting was held on August 15th. The minutes of the previous meeting were passed and the rules of the Society read, each rule being dealt with separately and passed unanimously, except rule 10. A suggestion that the entrance fee from a continuing visitor, if finally becoming a member, should be deducted from his account was agreed upon.

A visitor, Mr. Witts, asked as to the liberty of a visitor speaking at any meeting, and Mr Martin (the Financial Secretary) suggested an addition to rule 15, which was carried and will appear in the rules.

Mr. Cox was elected Treasurer. Mr. Martin, Financial Secretary, Messrs Saunders, Hawthorn, Johnson and Reginald Wiggins to the Committee.

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The electing of one lady for the Committee was postponed until sufficient ladies were present.

Mr. Mather and Mr. Butterworth were elected Auditors.

All the above elections were passed unanimously. The meeting then closed with a vote of thanks to the Stanley Ward Conservative Club for once again loaning their room.

The nett receipts for the evening were £4 17s. 6d. Members enrolled, 37 gentlemen, two ladies, and 4 juveniles. From Fulham 20, Chelsea 12 and outside area 11.

### St. Barnabas Wireless Club

Hon. Secretary. Mr. B. H. Hardy, 26, Pound Lane, Epsom.

This Club has changed its name from the Epsom and District Radio Society to St. Barnabas Wireless Club.

On August 7th, Bank Holiday, a Fete was held at Woodcote House, Epsom, in aid of the Epsom and Ewell Cottage Hospital, and the St. Barnabas Wireless Club gave Demonstrations in Radio Telephony from 3 p.m. until 8 p.m.

The set used on this occasion was a five-valve (1 H.F., 1 Rect., 3 L.F.) receiver loaned to the Club by a member, Mr. H. Penfold, the results obtained being highly successful. Unfortunately the clubs loud speaker went out of action immediately before the demonstration with the result that about eight pairs of phones had to be utilised in its place. With this arrangement, however, 150 to 200 people were able to listen-in during the course of the afternoon to telephony including the two excellent Marconi concerts at 5 p.m. and 6 p.m.

It is hoped that the efforts of the Club added to the success of the Fete.

The club holds meetings on Mondays and Thursdays from 8 to 10 p.m. in the Parish Room, Hook Road, Epsom.

### Otley and District Wireless Society.

Hon. Secretary, Mr. N. Weston, 24, Guycroft, Otley, Yorks.

The meeting on Thursday, August 17th, was not very well attended, due no doubt to holidays.

In the absence of the Chairman, the Hon. Sec. opened a discussion on type of set to be built for the Club's use. After an interesting discussion it was decided to atart on a five-valve set, 2 H.T, rectification and 2 L.T, with a multiple tuner. The scheme is an ambitious one, as even transformers are to be wound by amateur members. It is earnestly requested that all members endeavour to find more suitable quarters than those at present occupied, as facilities for proposed aerial are restricted.

### Bishop's Stortford and District Amateur Wireless Association

Hon. Secretary, Mr. J. Cooper, Halfacres, Bishop's Stortford.

A meeting was held at Halfacres, Bishop's Stortford, on Friday last, when Mr. W. S. Filby occupied the Chair. A paper was given by the Secretary, Mr. J. Cooper, entitled, "Notes upon the Construction of a Simple Receiving Station." This was illustrated by blackboard sketches and dealt with aerial and earth systems, tuning apparatus and crystal rectifiers. Parts of the apparatus described were passed round for inspection, and it was shown that any amateur with ordinary mechanical skill could make up an efficient set capable of receiving distant morse signals, the Writtle concerts and telephony within a radius of 30 miles. The apparatus designed for use with the crystal was such as could be adapted later for use with valves, and this conversion will be the subject of a subsequent lecture. On the motion of Mr. Attree, seconded by Mr. Rose, a vote of thanks was accorded Mr. Cooper for his paper.

Communications should be addressed to the Hon. Secretary.

### The Durham City and District Wireless Club.

Hon. Secretary, Mr. Geo. Barnard, 3, Sowerby Street, Sacriston, Durham.

The fourth meeting of the above was held at headquarters (Y.M.C.A., Claypath), on Friday, August 18th. The meeting was well attended, several new members were enrolled. It was very pleasing to note the presence of lady members, and also to hear that more are coming along. The chair was very ably taken by the Rev. T. H. Perkins, of Shadforth.

After the minutes were read and passed a most interesting lecture was given by Mr. Geo. Barnard, the Hon. Secretary, on "The Production of High Frequency Oscillations." He confined his remarks chiefly to the "spark" method, leaving the more advanced "valve" transmission to be discussed at a future meeting. After pointing out clearly the difference between static charges of electricity and electro-dynamics, he demonstrated the effects of static induction and described thoroughly the action of a condenser.

Frequency, amplitude, wavelength and damping were shown diagrammatically upon the blackboard. Inductance and capacity were explained in a most elementary fashion, the lecturer using several helpful analogies. Open and closed oscillatory circuits were shown upon the blackboard. The methods adopted to vary the amount of inductance and capacity, hereby varying the wavelength produced, were also shown.

The lecturer was heartily thanked. After the announcements a most lively discussion took place. Questions were asked concerning the last lecture on "The Electro-Magnetic Theory," and also upon the lecture just given. Atmospherics were discussed, and the secretary pointed out the advantage of a "double pole change-over switch," so that the apparatus could be disconnected from the aerial at will, at the same time connecting the aerial to earth, the aerial when so connected acting as a first-class lightning conductor.

Mr. Sargent, F.R.A.S., of the observatory, Durham, has consented to give a lecture at some future date.

It was decided to hold the meetings every Friday. The fourteen days interval, however, would still be adhered to between the important meetings, leaving the alternate Fridays for Morse buzzer practice, demonstrations and discussions of minor importance.

The meetings are still open for intending members. It is hoped shortly to organise a field day also a social evening. Another meeting held on Friday, August 25th, consisted of buzzer practice, five-minute speeches and small demonstrations with apparatus kindly lent by Mr. S. Kelly (Hon. Treasurer). The merits of a free library for the members will also be discussed.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

*In view of the serious interference which an oscillating receiver can cause to all other receivers in its neighbourhood, it is understood that for broadcast wavelengths, certainly, and possibly for all wavelengths, the Postmaster-General will in future allow no type of circuit which is capable of oscillating and so energising the aerial, either directly or through any circuit coupled to it.*

*The necessary consequence of this restriction is that if reaction of the type commonly used in the past is still employed, it must be in such a way that the oscillation point cannot be reached over the wavelength range of the receiver, however tightly the reaction coil is coupled, and with whatever values of filament voltage or plate voltage the set is worked.*

*In order to comply with this requirement, it is essential that the reaction coil should be sufficiently loosely coupled to the aerial inductances as not to set up oscillations or alternatively the reaction might be arranged between the grid and plate circuits of a high frequency amplifier as shown on p. 715 of this issue.*

*We strongly urge readers who are making or using sets of the usual reacting type to either (1) reduce the amount of reaction which they can employ to such an extent that they are perfectly satisfied that the set can never oscillate ; or (2) to cut out their reaction entirely.*

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**"C.L.B." (South Norwood)** *makes enquiries about four previous questions submitted.*

These questions were dealt with in reply No. 44 of this series.

**"J.B." (Dublin)** *asks (1) For criticism of a four-valve set. (2) If any advantage would be gained by using a grid potentiometer as well as, or in place of a grid condenser. (3) How to arrange for reaction in a resistance capacity circuit given to* **"W.D."** *on page 303 of June 3rd issue. (4) What telephony and Morse stations should be heard on four valves.*

(1) Quite O.K. (2) Potentiometer might with advantage be added to the first two valves, condenser and leak being retained for the third. (3) Put the reaction coil in the anode circuit of the third valve and couple it to the loading coil. (4) Not many at present. You might hear **2 LO, 2 MT** and **PCGG** with an open aerial, but hardly with a frame.

**"CAUTIOUS" (Essex).**—We regret that we cannot advise you on questions relating to patents.

**"R.G.W." (Wimbledon)** *asks (1) If H.F. variable transformers give the best all-round efficiency. (2) For a circuit to fulfil certain requirements. (3) Using a 6-volt accumulator what is the minimum number of filament resistances required.*

(1) Quite a good method, but not capable of covering as long ranges of wavelength as either resistance capacity coupling or interchangeable plug-in transformers. (2) A suitable circuit is shown in Fig. 7, page 438, July 1st issue, which includes the switching arrangement asked for. (3) One only is needed, although an additional separate control to the rectifier is sometimes useful.

**"C.L.W." (Johannesburg).**—(1) Two H.F. and one detector would be best, but we know of very little telephony in prospect which will have an effective range of 1,000 miles. (2) The use of resistance-capacity coupling saves the provision of a number of interchangeable transformers to cover various wavelengths, but it is very insensitive below 1,000 metres.

**"A.L.W." (Sheffield)** *asks (1) With reference to a reply to* **"L.H." (Mansfield),** *in June 10th issue, what would be a suitable A.T.I. (2) If a potentiometer referred to in the reply is correctly connected. (3) Data for making the transformer in the same diagram. (4) Range of set described, and if it would receive* **2 MT** *and* **PCGG.**

(1) 9″ × 6″ of No. 22. (2) Potentiometer is quite correctly wired in. It need not be added if zincite-bornite is used. (3) For the intervalve transformer use a core ½″ × 4″ of iron wires, with windings of 1 oz. and 3 ozs. of No. 44. An additional telephone transformer of normal type must be provided if L.R. telephones are to be used. (4) Up to about 30 or 40 miles from a broadcasting station. This set is unsuitable for **2 MT** or **PCGG** at the disiance. The circuit of Fig. 3, page 501, July 15th issue, is much better.

**"IRIS" (Derby).**—The aerial arrangement submitted appears to be the best that can be done in regard to the tram lines, but we are afraid that induction may be bad, particularly with a five-valve set. We do not think you will be near enough to any broadcast station to get good results on a single valve set.

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"**M.G.**" **(Clifden).**—We are afraid your requirements are rather vague. We cannot give detailed instructions for making a set in these columns, but the circuit might be as in Fig. 1, page 404, June 24th issue. A.T.I., 9" × 6" of No. 22. Coupling coil, 3" × 3" of No. 22. Closed circuit coil, 7" × 5" of No. 26. Condenser, 0·0005 mfds. Crystal—carborundum. Aerial as long and high as possible, up to 100'.

"**A.W.M.**" **(Peckham)** *has a Type* 2846, *serial* 74, *Marconi Wireless Set, and asks if it is possible to convert it into a crystal receiving set.*

We are unable to identify this set from the figures you give, which do seem possible to use. If you will let us have some description of the instrument, giving as much electrical information as possible, we shall be pleased to advise you.

"**W.B.**" **(King Williamstown)** *asks* (1) *For a diagram to convert a type* 16 *Marconi crystal set into a one-valve set.* (2) *If* 220 *volts A.C. transformed down to* 8 *or* 3 *volts to put through a motor-car induction coil would be suitable for short range transmission.* (3) *If there is such a thing as being screened from a station, the cause of it and if it can be overcome.* (4) *If his crystal battery terminals should be shorted when no battery is used.*

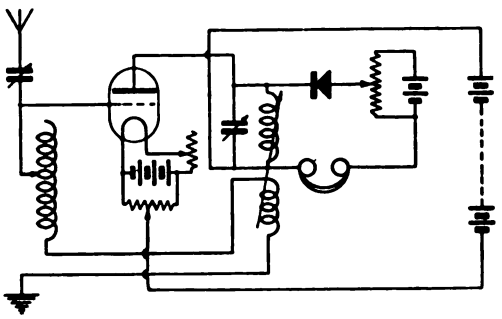

*Fig.* 1.

(1) Alter the set to the diagram shown (Fig. 1). (2) Probably, but we cannot give exactly voltage to step down to, as this would depend on the winding of the coil. (3) Screening does occur in special cases as, for instance, by the presence of a mountain mass between transmitter and receiver. In other cases cause may be very difficult to ascertain, and when ascertained it may be difficult to remove. (4) Present arrangement of crystals is O.K. It is not necessary to short the battery terminals when no battery is employed.

"**R.G.P.**" **(Salford)** *asks* (1) *Winding data for certain slab inductances.* (2) *If a variometer tuner is suitable for receiving telephony with a three-valve amplifier.* (3) *Winding details for certain H.F. transformers.*

(1) With a series condenser of 0·001 mfds. the coils should have the following number of turns—25, 50, 80, 125 and 150. (2) Yes. (3) We cannot give the exact data, as the values vary considerably with slight differences in the way the wires fit on. Try ebonite formers 1½" diameter, with windings varying from 30 turns per coil to about 220, winding one coil over the other with insulation of varying thickness of paper.

"**OSMOSIS**" **(Leeds)** *asks* (1) *Amount of No.* 26 *wire and size of former for H.F. inter-valve transformers of broadcasting wave.* (2) *For diagram of a one-valve telephone transmitter for five miles range.* (3) *Where to purchase a Johnson-Rahbek loud speaker.* (4) *How to listen-in on his own transmission with a telephone transmitter.*

(1) About 40 turns on a former 5½" diameter for each winding, windings separated by two or three layers of paper. Exact adjustment must be made by experiment. (2) See diagram (Fig. 2).

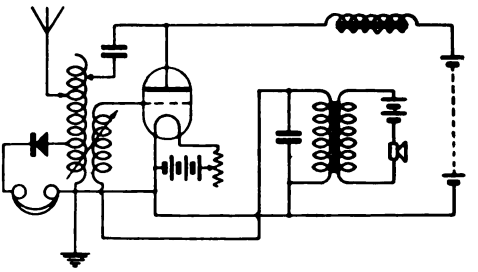

*Fig.* 2.

(3) We do not think this instrument, which is covered by patents, is on the market, at any rate in this country. (4) Crystal and telephones might be tapped across a few turns of the A.T.I. as shown in the diagram.

"**A.C.M.**" **(Brazil)** *asks* (1) *How to add slab inductances to the Marconi* 70*a tuner to obtain a wavelength up to* 20,000 *metres.* (2) *How to insert a crystal in place of a "Q" valve in the Marconi* 55*F amplifier.* (3) *Address of agent for reliable firm of American wireless telegraphy instrument makers.*

(1) The tuner is not suitable for alteration in this way without opening up and introducing suitable coils in each circuit. It would be much simpler to make an entirely fresh tuner for the purpose. (2) This also cannot be done without extensive structural alterations to the instrument. You might, of course, tap off a lead to the anode of the last H.F. valve through a crystal and telephones and back to the H.F. positive. (3) We do not know of agents holding stocks of American goods.

"**G.B.**" **(Acton)** *asks* (1) *For a diagram of his two-valve circuit and panel.* (2) *If it would receive* **PCGG.**

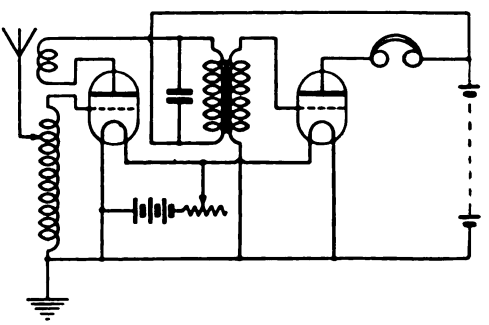

*Fig.* 3.

(1) We cannot say how your panel is wired up, but it *might be* wired as in the diagram (Fig. 3), which gives the complete circuit as requested. (2) It should do so on the new power to be used.

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**"H.W.P." (Birmingham)** *is having difficulty in short wave reception, and asks* (1) *For alterations in the connection of his three-valve receiver, to admit of either one valve being used alone, or all three.* (2) *For criticism of his circuit and way of getting improvement in the reception of amateur telephony.* (3) *Switching arrangements for connecting aerial tuning condensers either in series or parallel.* (4) *Probable reason why he does not receive signals sufficiently loud for operating a loud speaker.*

(1) See Fig 4. (2) Your diagram is rather involved and somewhat difficult for us to follow. Why have you connected your two condensers in parallel? A closed circuit condenser is much too large for use as a Vernier. The smaller condenser might be used with advantage for tuning reaction circuit and should be bridged across its ends. I think your main trouble is due to inability to tune critically, mainly because your plate circuit is not provided with a tuning condenser. Ebonite extension handles on the condensers would facilitate critical tuning. (3) This is shown in the diagram. For short wave telephony reception it is essential that you should connect the variable condensers in series with the aerial tuning inductances. (4) Your aerial is not very high, and is lower than both house and tree, which is not the best arrangement. Cannot you arrange to erect a light mast on the roof, as shown on p. 260, May 27th issue? And cannot you arrange to erect a two-wire aerial?

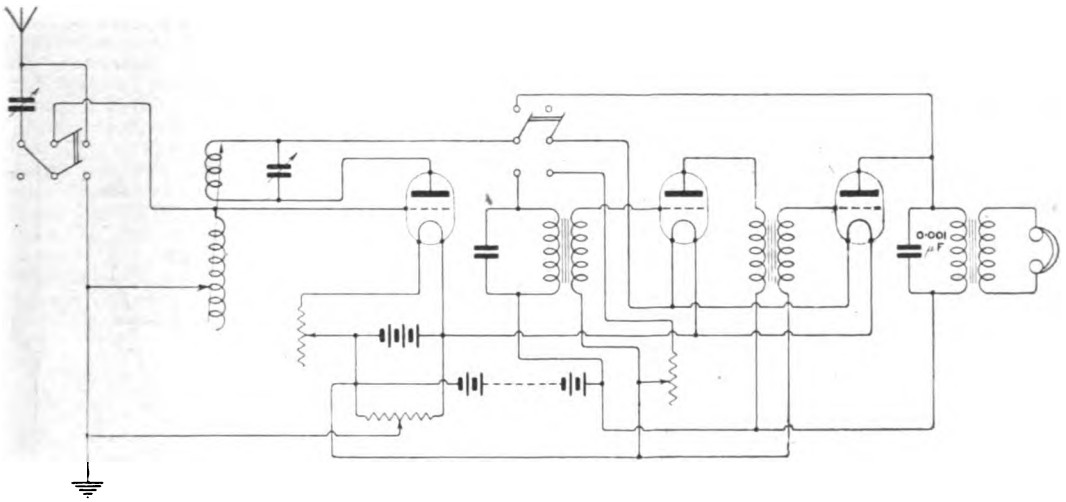


*Fig. 4.*

**"J.H.C." (W.4)** *asks* (1) *For an explanation of the process of "tuning in."* (2) *Whether a low frequency valve amplifier can be used for increasing the strength of signals in an ordinary telephone receiver (not wireless).*

(1) To completely describe the process of "tuning in" signals is rather beyond our scope. If you could find a friend who could give you a few minutes' tuition, you would easily grasp the whole process, and the help that you would gain from him would be far more than we could give you in ten pages. In brief, you should insert tuning coils in the three-coil holder whose wavelength ranges tally with one another. The filaments should be of brightness nearly equal to that of the usual metal filament lamp. Condensers must be moved until signals are heard, and then further varied to improve the signal strength Increases in the value of the aerial tuning condenser should be accompanied by increases in the value of the reaction tuning condenser and closed circuit tuning condensers. The reaction coil should be moved away from the closed circuit coil as far as possible, as this will eliminate re-radiation, and at the same time probably produce greater signal strength, and finally, readjustment of the various condensers may be made during reception. (2) Yes. A 3 or 4-valve low frequency amplifier can be connected in place of the ordinary telephone receiver of the ordinary land line telephone, and the output terminals connected to the loud speaker as you propose; or if it is only your desire to produce speech of great intensity, a microphone battery and step-up induction coil are connected in series. The secondary of the coil is taken to the grid of the first low frequency valve the remainder of the connection being as is usual in a low frequency amplifier. For producing speech by this method of intensity considerably above that of the ordinary voice, you will require at least five valves, and as a result there may be some distortion, unless specially designed intervalve transformers are used. Of course, telephony is always considerably distorted by the loud speaker itself.

**"J.E.R." (Kingsbury)** *wishes to make a crystal set and asks* (1) *If the coil in the Reinartz Tuner can be oval or rectangular, using the same quantity of wire as given in the issue of May 13th.* (2) *If a crystal could be used with this tuner and valve added later.* (3) *Can celluloid be used as an insulator.* (4) *Would three wireless stations within five miles give a beginner any trouble.*

(1) Yes, if desired. The wavelength range will come out slightly different according to the shape employed. (2) No, not at all effectively. (3) Celluloid is not a very good wireless insulating material, but may be used if nothing better is available. (4) Probably not, at any rate on a



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crystal set, but we should advise using a two-circuit loose coupled receiver.

**"A.T.I." (Ealing)** *asks* (1) *Of what height must his aerial be to be efficient.* (2) *If a twin or single wire aerial is the better.*

(1) The aerial must not be less than 20′ high, preferably 30′. *N.B.*—You cannot use reactance with a crystal set. (2) Use a twin wire, 7/24 or similar size of silicon bronze or galvanised steel will be suitable.

**"T.H.B." (Holyhead)** *gives a list of parts and asks if they can be made into a set; if so for suitable dimensions.*

0·0005 mfds. condenser. Potentiometer former, 6″ × 1″ wound with No. 36 Eureka. Tuning inductance, double slide, 9″ × 6″ of No. 22.

**"A.W.S." (Tooting)** *asks for criticism of a circuit and whether the values employed are correct.*

The circuit is O.K. and the values are quite suitable except that the parallel A.T.C. should not be used at short wavelengths.

**"C.F.H." (Nottingham)** *asks* (1) *For a circuit diagram of a five-valve receiver embodying* 2 *H.F.,* 0 *rectifier, and* 2 *L.F.* (2) *A diagram of a seven-valve receiver using* 3 *H.F.,* 1 *rectifier, and* 3 *L.F.*

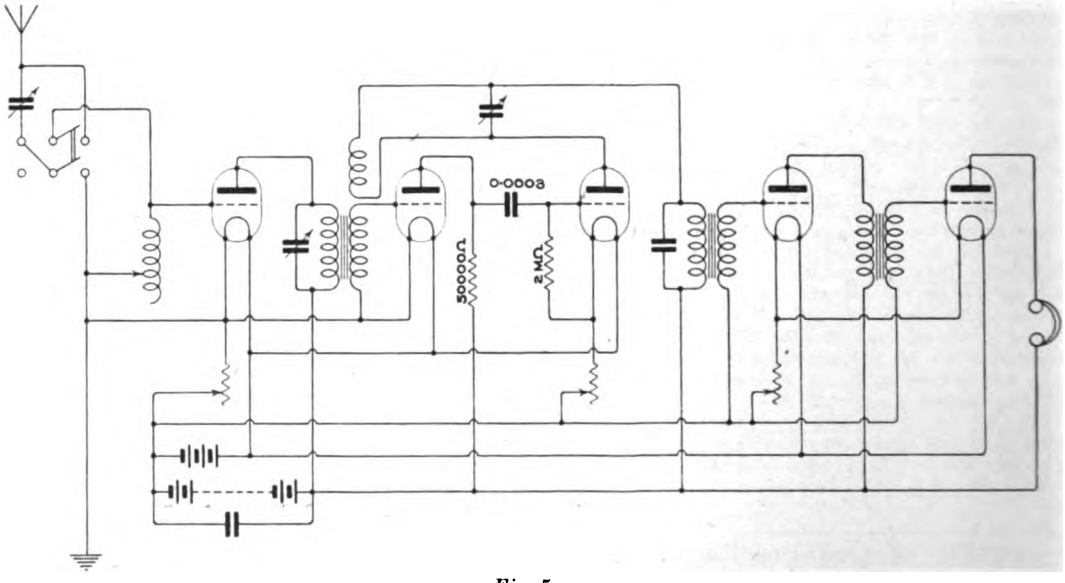


*Fig.* 5.

(1) See Fig. 5. (2) The method adding H.F. and L.F. circuits is easily apparent.

**"V.H.T.L." (Hampstead)** *asks* (1) *The name of a wireless society in his district.* (2) *The maximum wavelength of his aerial when connected to a tuning coil consisting of* 167 *turns,* 4¼″ *in diameter.* (3) *The dimensions of a loading coil required to tune to* 6,000 *metres.* (4) *Why it is that he is able to hear all of the more important London amateur stations (and particularly* **2FQ**), *and yet is unable to receive the transmissions from Marconi House as loud as from the amateurs.*

(1) The nearest Society would probably be Highgate Wireless Society, and the address of the Secretary is Highgate Literary and Scientific Institution, South Grove, Highgate, N. (2) Your set will probably not tune beyond 1,700 metres. When the aerial tuning condenser is connected in parallel the reaction coil with its tuning condensers will probably tune to 2,500 metres. (3) To load the aerial we would recommend you to use a number of basket coils, assembled along an ebonite tube, and spaced from one another by about ⅛″. If these coils have an internal diameter of 2″ and an external diameter of 4″ and are wound with No. 26 D.S.C., you will require from 8 to 10 to load your aerial to a wavelength of 6,000 metres. The closed circuit need not necessarily be further loaded, as it will probably function aperiodically, but if you want precise tuning in this circuit, and are desirous of working with fairly loose coupling between aerial and reaction circuits, it will need to have a few basket coils connected in series with it. (4) We cannot understand why you are able to receive amateurs' stations located in various parts of London, and yet have difficulty in receiving **2LO**. In our experience **2LO** can be received in London on the simplest type of crystal set, whilst if more than a few miles away, for many of the amateurs you mention a single valve receiver at least is required. Make two special basket coils for short wave work, consisting of 44 turns of No. 26 D.S.C., and having a mean diameter of 2¾″. Bridge the reaction coil with a tuning condenser, and place one over the other to give reaction effects, and we think you will find it difficult to miss the signals which you complain you are unable to receive successfully.

**"J.R." (Newcastle-on-Tyne)** *asks* (1) *For criticism of a crystal set.* (2) *For criticism of aerial.* (3) *If certain* 2,000 *ohm telephones are suitable for telephony.* (4) *What concerts he should hear.*

(1) O.K., except that the potentiometer should be wound with eureka, or similar wire, instead of copper. Range probably up to about 3,500 metres. (2) Not good. Bring down lead from the end of the aerial nearest to the house. (3) Yes. (4)

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Probably none until the broadcasting station at Newcastle starts operations.

"**F.T.G.**" **(Kensal Rise)** *is constructing a long range multivalve receiver, and asks* (1) *for a circuit diagram comprising two H.F. valves, one detector and one L.F., with series parallels for the aerial tuning condenser, switching for arranging either transformer or resistance capacity coupling between the H.F. valves, separate filament resistances for each valve, separate potentiometer control where necessary and switches to cut out* (a) *one H.F. valve;* (b) *one H.F. and one L.F. He also requires values of condensers and resistances.* (2) *Particulars for the construction of the high frequency interchangeable transformers.* (3) *Details of construction of the low frequency transformer and telephone transformer.* (4) *The best type of valves as H.F. detector and L.F. amplifiers.*

(1) See diagrams Figs. 6 and 7. (2) Use 1" polished ebonite rod as a former on which to wind the transformers. Four valve legs can easily be screwed into one end by making tapped holes. If you are desirous of using transformers of various values and having them interchangeable. Where more than one H.F. transformer is used, it is essential that they shall all have exactly the same values, or otherwise one transformer will filter out signals on wavelengths on which the other will operate best. Wind on the required number of turns for the wavelength required in the form of a single layer, and insulate primary from secondary with a single layer of empire cloth. As an approximate guide, 600 turns of No. 40 S.S.C. give 600 metres. Make primary and secondary windings both in the same direction, and the two leads passing from one end of the transformer are taken to grid and plate. (3) The bobbin should measure 1¾" long by 1¼" in diameter. The core, which should consist of fine soft iron wire, should have a diameter of 5/16 of an inch, and the primary should be wound to a depth of ¾" with No. 46 S.S.C., and the secondary up to 1¼" with No. 48 S.S.C. The core wires should be bent back along the sides of the transformer, those from one end being intermeshed with those from the other. For the telephone transformer wind the primary of the same

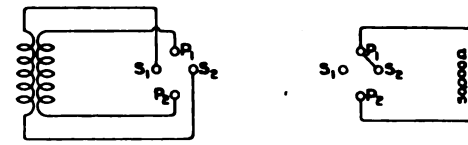


*Fig. 7.*

dimension as just given, but with No. 48 S.S.C., and the secondary also to the same diameter, but with No. 34 S.S.C.

"**J.H.J.**" **(Rotherham)** *asks* (1) *Whether his circuit is suitable for the reception of telephony with a single head telephone receiver and "R" valves, and* (2) *the capacity of the variable condensers in aerial and reaction circuits.*

Your circuit is incorrect. The amplifier is built up on the resistance capacity principle, and you should therefore include high resistances of the order of 50,000 ohms in the plate leads. Resistance capacity coupling, however, is not efficient for use on short wavelengths, and you will be well advised to use a single valve receiver with tuned reaction circuit, followed by one low frequency amplifier, and if this does not satisfy your requirements, you might add one stage of high frequency amplification. (2) For short wave reception, the aerial tuning condenser should have a maximum value of 0·001 mfds., and a small blocking condenser of value of about 0·001 might be connected in series with it to provide fine tuning. The condenser which bridges the plate circuit should have a value of 0·0005 mfds. Both condensers should be of the air dielectric type.

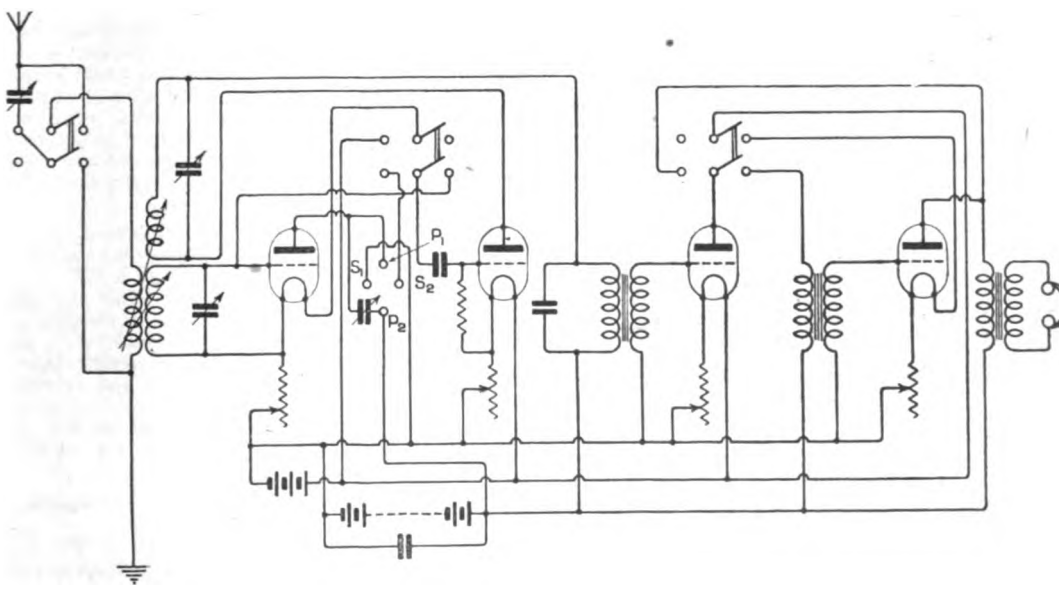


*Fig. 6.*

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"**J.D.B.**" **(Kintyre)** *asks if a circuit which he submits, consisting of the usual tuned aerial circuit with coupled plate circuit, is suitable for the reception of C.W., and with the addition of amplifying valves, broadcasted telephony.* (2) *Whether the addition of one H.F. and one L.F. would permit of reception from* **PCGG** *and* **2MT.** (3) *If not, how many valves would be required, and* (4) *Suitable circuit.*

(1) Yes. (2) and (3) Yes. (4) See Fig. 8.

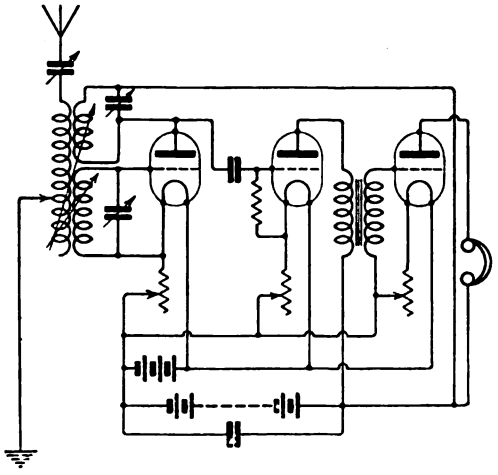

*Fig.* 8.

"**ELECTRON**" **(Gloucester)** *asks* (1) *If the enclosed diagram of circuit is correct.* (2) *If the Writtle and Paris music can be received in Gloucester.* (3) *How to make a telephone transformer for* 300 *ohm telephones.* (4) *What value grid leak to use with this circuit.*

(1) Yes. (2) Possible, but doubtful in the case of Writtle. (3) Use a core of $\frac{1}{4}$" × 4" of iron wires; for the primary winding 3 ozs. of No. 44 and secondary 6 ozs. of No. 32 (No. 28 is too thick). (4) About 1 megohm. Adjust by experiment.

"**J.L.S.**" **(Huddersfield)** *asks* (1) *With reference to a five-valve circuit why is No.* 5 *called a "telephone transformer," and Nos.* 3 *and* 4 *L.F. transformer.* (2) *Where he can obtain the plugs and jacks.* (3) *Types of coils and condensers recommended to use with his set.*

(1) We cannot say without detailed information, but unless the set is to be very inefficient it is probably designed for H.R. telephones. There is no hard and fast distinction between inter-valve and telephone transformer. (2) Try the makers of telephone apparatus, such as the G.E.C., or various wireless dealers advertising in this magazine. (3) Any of the normal types should be satisfactory.

"**RECORDER**" **(Isle of Man)** *has trouble with his relay and asks for advice.*

Your aerial is very poor. Your single 73′ wire would probably give better results than the combination. There are various possible explanations of the unsteadiness of your circuit, *e.g.*—(1) Variation in voltage of either battery. (2) A disconnection, partial or complete, in one of your grid windings. (3) A soft valve. (4) Leaky windings of your relay. Almost all arc stations work on a double note in the way you mention for Leafield. This is because they signal by making a slight change of wavelength, not by switching on and off their power.

"**L.R.H.**" **(Birmingham)** *asks* (1) *If the diagram submitted is suitable for a beginner and correct.* (2) *What wavelength range would a certain winding give.* (3) *What type and capacity condenser should he use.*

(1) Quite O.K. and suitable. (2) About 1,200 metres. (3) Variable, air di-electric. Capacity about 0·0005 mfds.

"**A.L.**" **(New Brighton)** *asks if a certain circuit is correct.*

The circuit shown is quite O.K. except that when the A.T.I. and A.T.C. are in series the first valve is tapped across both. The valve should be tapped across A.T.I. only, and this should be on the earth side of the A.T.C.

"**T.K.R.**" **(Norwich)** *asks the gauge of a sample of wire and whether suitable for an aerial.* (2) *Whether crystal circuit sketched is correct.*

(1) No. 7/26 cable The wire is quite suitable, but we do not care for the braided cotton covering for an aerial, as it is liable to lead to dielectric losses and is very unsightly. (2) Quite O.K.

"**AMPLIFIER**" **(Folkestone)** *encloses a diagram of a three-valve circuit and asks where the reaction condenser should be introduced.*

The circuit shown is O.K., except for the direct connection between the first grid and the last plate. The reaction condenser should be introduced in this lead, and can be fitted with a series switch if desired.

"**G.J.**" **(Leicester)** *asks for advice as to installing a one-valve* 10*-watt transmitter.*

Your question is too general for us to assist you much. We might say apply to the P.M.G. for a licence, buy a set from a reputable maker and erect as large and unscreened aerial as possible and then start work, but this is possibly not the advice you require. If you will let us know the *actual points, e.g.* (type of circuit, price, method of construction, insulation or adjustment, type of aerial, etc., etc.) in which you are in difficulty, we should be happy to advise, but a treatment of all the *possible* questions arising out of your enquiry would require about one complete issue.

"**B.A.W.**" **(Ealing)** *asks for criticism of one-valve set.* (2) *Capacities for various condensers in it.* (3) *If it can be made of mica and foil.*

(1) Circuit is O.K. except that when the plug is inserted in either II or III the corresponding grid winding should be broken, and all valves not in use should have their filament current switched off. (2) *A* and *B* 0·0005 mfds. *C* and *D* 0·001 mfds. (3) *A* and *B* should be variable, of air dielectric. *C* and *D* might be mica and foil, say 4 mil. mica 5 sq. cms. of overlap per pair of foils, and four foils.

"**J.A.**" **(West Somerset)** *asks two questions about his aerial.*

(1) By all means erect a 40′ mast at B. The raising of any part of an aerial is almost always advantageous, whatever the general configuration of the land or aerial may be. (2) We should prefer the single one.

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"C.H.T." (Mildenhall) *asks for a diagram of a five-valve set suitable for reception of short wave telephony, for making use of several components he has on hand.*

See Fig. 9.

We recommend you to add one high frequency valve and an additional note magnifier, as shown in the circuit diagram, Fig. 10. We regret we cannot advise you on questions relating to patents, and the circuit we recommend to you obviously embodies

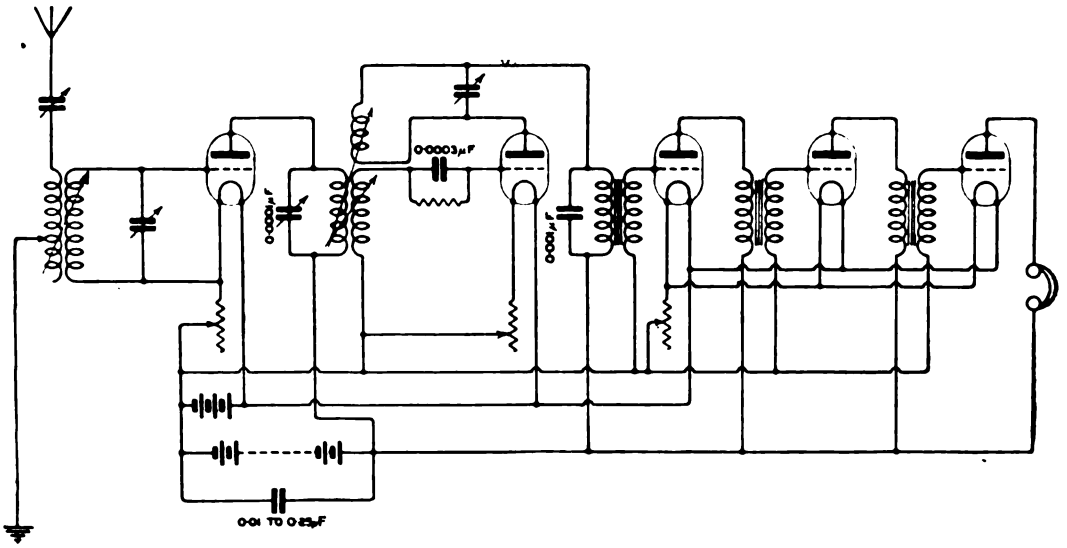


*Fig.* 9.

"H.A.H." (Rotherham) *has a two-valve receiver consisting of the usual detector to oscillator valve, followed by one note magnifier, and asks how to add two additional valves in the most efficient manner, and whether the circuit we recommend*

the use of patents held by the Marconi Company, but we believe that the Marconi Company will have no objection to you making use of their patents for experimental and research purposes. A statement on the subject appeared on page 479 of the July 15th

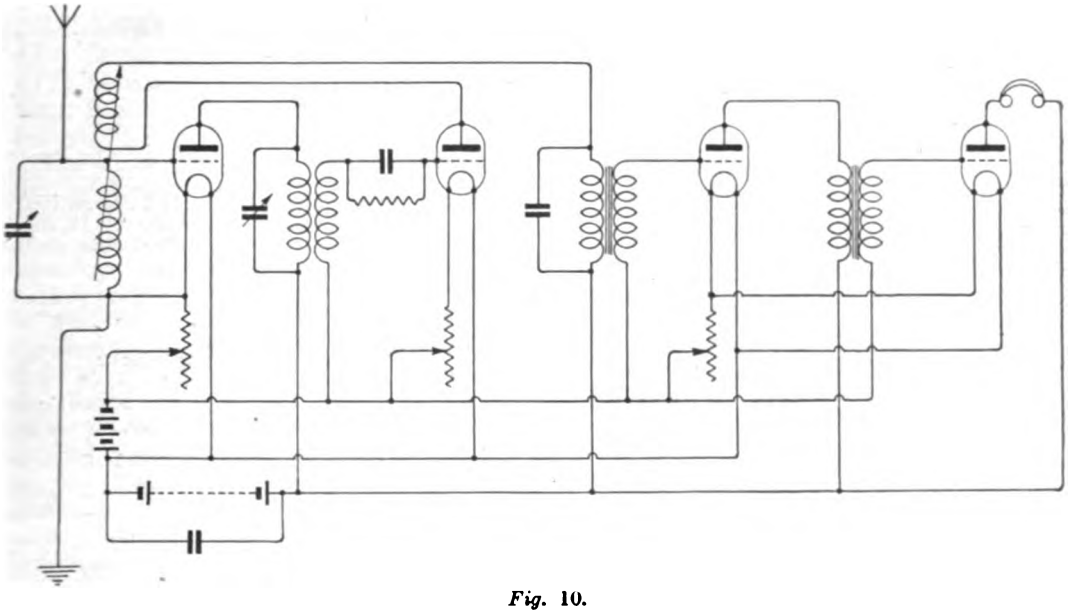

*Fig.* 10.

*would infringe Marconi patents. He also asks for times and wavelength for transmission by the various stations.*

issue. The list of regular transmissions which we publish from time to time has been revised and accompanied the issue of August 5th.

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**"RADIX" (Nottingham)** *asks* (1) *For criticism of a circuit sketched.* (2) *If an H.F. transformer and telephones would give better results.* (3) *Where can he obtain a chart of wireless stations and their wavelengths.* (4) *If a certain arrangement of aerial is satisfactory.*

(1) The circuit is incorrect. Alter as in diagram given to **J.S. (Liversedge)** below. (2) Yes, it should definitely improve results. (3) See chart in issue of August 5th, 1922. (4) No, this is undesirable.

**"J.S." (Liversedge)** *asks* (1) *For criticism of a circuit.* (2) *How to add two L.F. valves.* (3) *For dimensions of a loose coupler to tune down to between* 150 *and* 600 *metres with a* 0·001 *mfd. condenser.*

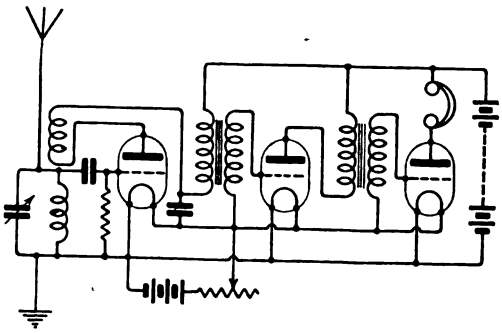

*Fig.* 11.

(1) Circuit is quite O.K. except that a parallel condenser of 0·001 mfd. is highly undesirable for short waves. (2) See diagram (Fig. 11). (3) 0·001 mfds. is too big, and 0·0005 mfds. for the closed circuit dimensions might be primary 5″ × 3″ of No. 22, and secondary 5″ × 2½″ of No. 24.

**"R.E.B." (Bristol)** *asks* (1) *If a certain arrangement of his aerial is O.K.* (2) *If a tramway system will interfere with his reception.* (3) *If he will be able to receive* **2 MT** *with his aerial.* (4) *How many valves will be required to receive* **2 MT.**

(1) It would be better to bring the aerial lead outside the building as close as possible to the instruments, staying it as far as possible from the walls all the way. The bathroom waterpipe might be used for the earth, but under the circumstances an earth buried outside the receiving room would probably be better. (2) It may give some induction trouble, particularly if much amplification is employed. (3) Probably, especially if modified as suggested. (4) Three valves should be sufficient.

**"A.S." (Bayswater).**—(1) See Fig. 2, page 313, May 13th issue. (2) Core ½″ × 4″ of iron wires, H.R. winding 3 ozs. No. 44, L.R. winding 6 ozs. No. 32. (3) Range would probably be up to about 20,000 metres. You should get all the larger European stations, and American stations under favourable conditions.

**"D.W.T." (Cambridge)** *sends a characteristic of a valve and asks* (1) *Best grid potential for* (*a*) *oscillation,* (*b*) *rectification,* (*c*) *amplification.* (2) *How the grid potential is applied.*

(1) (*a*) Almost anywhere. (*b*) Without grid condenser about minus 4, *i.e.*, the lower bend of the curve. From the characteristic the valve would appear bad as a rectifier. (*c*) About zero, *i.e.*, the straight part. (2) By means of potentiometer across the L.T. battery, with additional series cells if necessary.

**"J.D.B." (Greenock)** *submits a single valve circuit for criticism and asks* (1 & 2) *If two-valve will be sufficient to enable the Dutch Concert to be heard at Greenock, or if three valves will be necessary.* (3) *What arrangement of valves to use.* (4) *Indicate additions necessary to circuit to obtain H.F. amplification.*

(1) No. The side of the closed circuit condenser remote from the grid of the valve should be connected to the negative end of the filament battery. (2) At least three valves will be required for satisfactory results. (3) One H.F., one detector and one L.F. is a very good arrangement. (4) Fig. 2, page 304, June 3rd issue, shows a very good circuit for a complete receiver, the first valve of which is arranged for H.F. amplification, the same arrangement being suitable for your set.

**"E.T." (Seaham Harbour)** *asks* (1) *For a diagram of a two-valve note magnifier to be added to a single valve panel with switch mounted on the note magnifier, to use either one or two valves.* (2) *Name of the station on* 2,600 *metres, having a carrier wave and audible* 20 *feet away from the telephones with a two-valve set.*

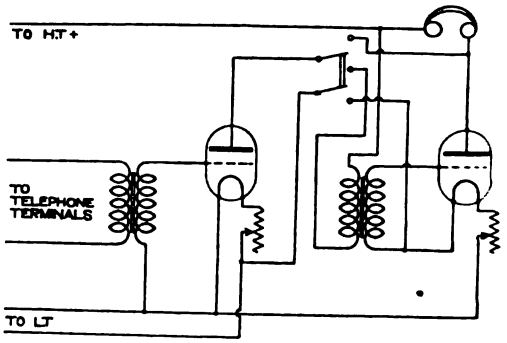


*Fig.* 12.

(1) See diagram (Fig. 12) (2) Information is rather limited to reply with certainty. It might be FL, but we should hardly expect this station to be so strong at such a distance.

## SHARE MARKET REPORT.

Prices as we go to press, August 25th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 6 | 0 |
| ,, Preference .. .. | 2 | 2 | 6 |
| ,, Inter. Marine.. .. | 1 | 9 | 6 |
| ,, Canadian .. .. | | 10 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 3 | 6 |
| Preference .. .. .. | | 14 | 3 |

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THE
WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 24. SEPTEMBER 9TH, 1922. WEEKLY

# Meteorological Wireless Codes.

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

METEOROLOGICAL CODES.

1. The information reported in weather telegrams may conveniently be classified and referred to subsequently under the following six headings :—

(*a*) Surface observations, including barometric pressure, wind force and direction, temperature, visibility, humidity and amount of cloud.
(*b*) Upper-wind observations, including height, direction and force of the upper winds.
(*c*) Upper-air temperature and humidity.
(*d*) Reports from ships at sea (surface observations).
(*e*) Information regarding ice conditions.
(*f*) Forecasts.

2. Definitions in meteorology—*cyclone* and *anticyclone*.

The terms " cyclone " and " anticyclone " are so frequently used in weather reports that it is thought better to deal with them in a separate paragraph. Other terms, the meaning of which is obscure, will be explained as they occur. On the weather-maps published in the daily newspapers, places of equal barometric pressure (reduced to sea-level and latitude 45° for standard comparison) are joined by lines known as *isobars*. They are analogous to the contour lines on a map of land areas. The isobars enable us to readily see the shapes of the areas of high and low pressure. Areas of high pressure are called anticyclones or " highs," and areas of low pressure, cyclones or depressions or simply " lows." Where the isobars are packed closely together, the barometric gradient is steep and the winds powerful. Now it might appear at first as though the air would blow across at right angles to the isobars from places of high pressure to " lows." Any such conditions would, however, be very short-lived, for in an interval of time, measured only perhaps in seconds, the " low " would become a high pressure area and *vice versa*. The effect of the earth's rotation under the moving

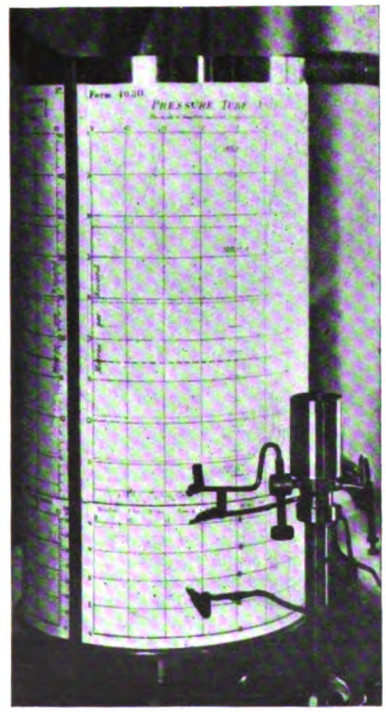


*Fig.* 1. *Dine's High-pressure tube anemometer gives a continuous record of the direction and velocity of the wind. Every gust (however small) is recorded by the upper pen, whilst the lower, answering to the movements of the vane outside, records the direction.*

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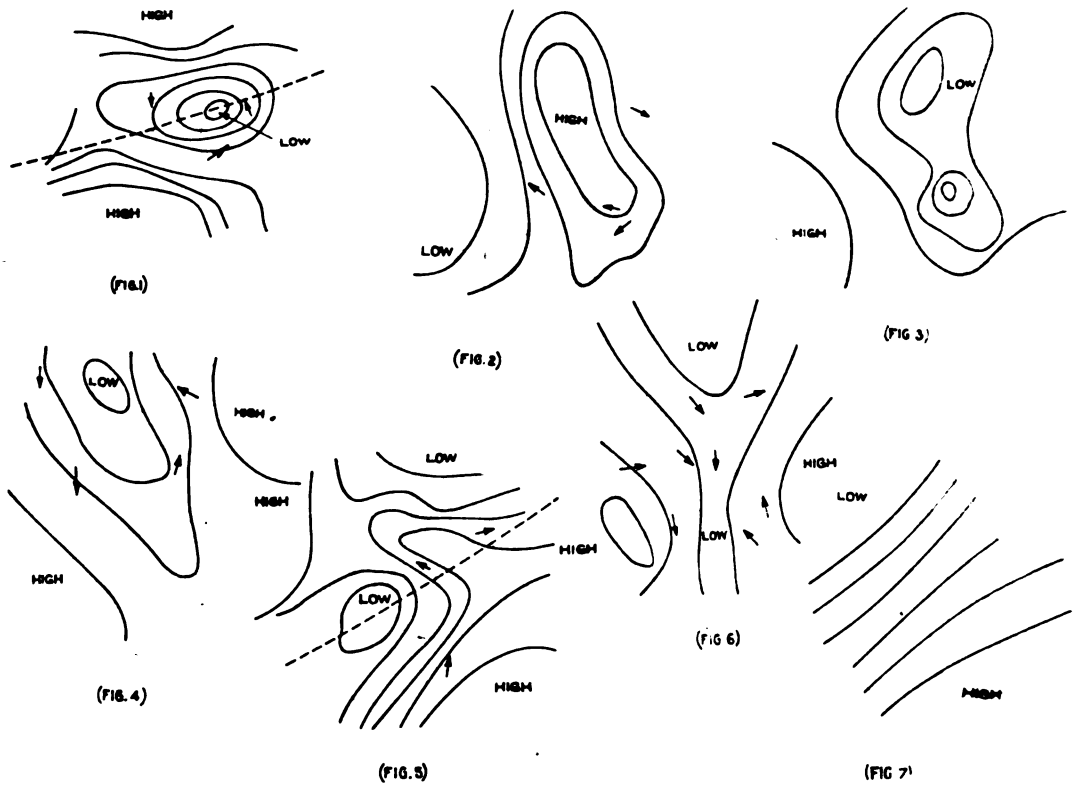
## *Fig.* 2. NATURE OF WEATHER TO BE EXPECTED.

(*Fig.* 1.)—*Cyclone. Typical Arrangement of Isobars. North of the equator, the wind blows round the depression counter clockwise in accordance with Buys Ballots' Law. Strong winds are associated with closely packed isobars, in which case the depression is deep. Rain near the centre of the "low" especially heavy rain on the north-east side with dull and overcast sky to the east and south-east. Depressions usually come up from the south-west or west and move across towards the north-east or east. Signs of approaching cyclone, fall of barometer, strong south or south-west wind, overcast and cloudy sky. Signs of passing of cyclone, wind changes to north or north-west and increases in strength, barometer rises. Small arrows show wind direction.—N.B. The broken line shows the track of the observer. For the other positions, conclusions must be drawn from the diagram.*

(*Fig.* 2.)—*Anti-cyclone. In the case of an anti-cycle, the isobars are usually further apart and therefore winds are lighter than those associated with cyclones. Usually fine and bright weather, seldom any rain and then only light showers, some cloud. Anti-cyclones very often cover a very large area. Their chief characteristic is that they move but slowly and irregularly, often remaining about for weeks at a time, whereas all the phenomena associated with a cyclone may be passed through in 24 hours.*




(*Fig.* 3.)—*Secondary Depression. A secondary is usually found on the southern side of a "low," and when associated with a deep depression the secondary often causes strong winds by crowding together of the isobars. Heavy rain and thunderstorms are frequent.*

(*Fig.* 4.)—*V-shaped Depression. A more elongated "secondary." Signs of approaching V-shaped depression—strong southerly winds, much cloud and very heavy rain, with very marked change as the central portion of the depression passes over. Then rapid clearing of sky and falling temperature and change of wind from a northerly direction. The central portion is often a region of very heavy squalls.*

(*Fig.* 5.)—*Wedge. The long arrow points to a wedge of high pressure between two "lows." Signs of approaching wedge. A very rapid "clearing up" of weather and fall of wind after the passage of a depression. Sequence of weather changes during passage of wedge. Front of wedge, extremely fine weather with light winds from north, then as central line of wedge passes, a change of wind from a south or south-west direction followed by rain and clouds associated with the approaching "low." The weather is often comparatively calm as the central portion of the "wedge" approaches.*

(*Fig.* 6.)—*The "Col." The typical "col" is a narrow straight "pass" between two anti-cyclones. This region is the meeting place of winds from many different directions and consequently fog in cold weather and thunderstorms in hot weather are the phenomena associated with this type of isobar arrangement.*

(*Fig.* 7.)—*Straight Isobars. An arrangement of isobars not frequently met with in these latitudes. The weather experienced is usually cloudy and rainy on the "low" pressure side and fine and warm on the high pressure side.*

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air causes the latter to be apparently deflected to the right in the northern hemisphere. Thus the wind blows almost along the direction of the isobars and reaches the "low" by a kind of spiral course. In the case of an area of high pressure, the wind blows round the area of high pressure in a clockwise direction to the line joining the centres of high and low pressure.

Buys Ballots' Law conveniently summarises these issues thus: "stand with your back to the wind, the low pressure area will be on your left hand." This applies only to the northern hemisphere, the reverse is true in the southern hemisphere.

Although the cyclone and anticyclone are the chief arrangements of isobars met with, there are other typical shapes. These are illustrated on page 746, together with a brief description of the weather associated with each type.

3. Having outlined the different types of weather associated with *typical* arrangements of isobars, the next step will be to give the codes used in the weather reports issued by the central meteorological service. The amateur will then be in a position to de-code these (where necessary) and gain information several hours in advance of the approaching weather.

The "general inference" (page 612, *The Wireless World and Radio Review*, August 12th) is in plain language and needs no further comment at present.

CODED FORECASTS FOR DISTRICTS. A specimen forecast in code is given below, together with a brief explanation. For full information as to the method of decoding reference should be made to M.O. Publication, No. 244, "Forecast Code for the Abbreviation of Weather Forecasts transmitted by Telegraphy or Radio-telegraphy," which may be obtained from H.M. Stationery Office, Kingsway, price 1s.

*Fig. 3. Strato-cumulus clouds, taken from an aeroplane 5,000 ft. above the earth, and at 1,000 ft. above the cloud level.*

Group 999, England and Southern Scotland, taken collectively (appended to the "general inference" issued at 2000 G.M.T.).

SPECIMEN. (For decode *see* Fig. 4.)

09218. Baltic 16508 20042 19299 22457
22455 32024 40405 52427 90447 91501

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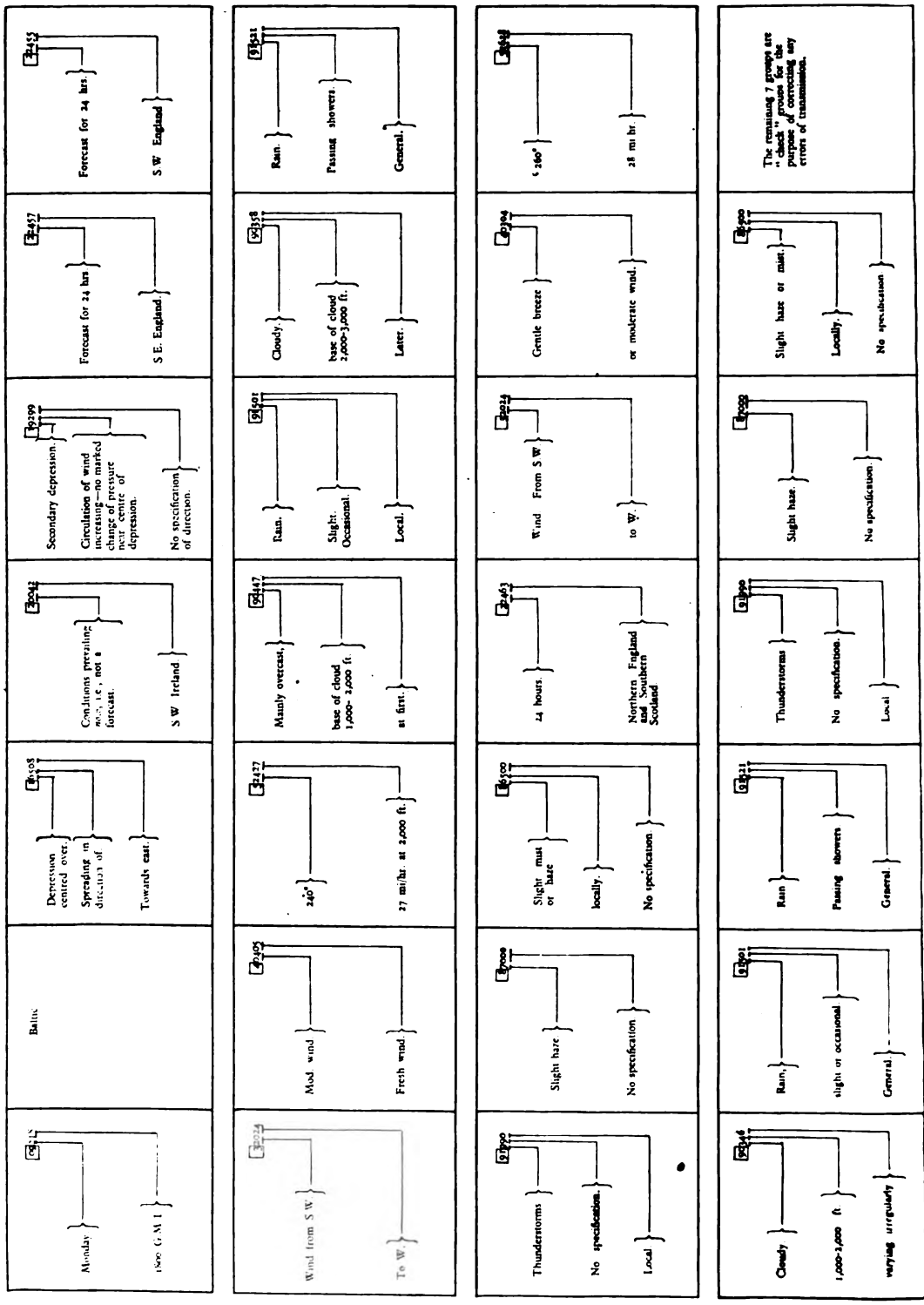


*Fig. 4. Decode of Specimen Message.*

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90358 91521 91990 87000 86500 22463
32024 40304 52628 90346 91501 91521
91990 87000 86500 00800 81304 65885
97113 26885 95— 70639

The "check" groups are obtained by writing down in vertical columns the preceding groups:

| | (a) | |
|---|---|---|
| 09218 | 0 | |
| 16508 | 0 | First group |
| 20042 | 8 | of check figures. |
| 19299 | 0 | |
| 22457 | 0 | |
| 22455 | 8 | |
| 32024 | 1 | Second group |
| 40405 | 3 | of check figures. |
| 52427 | 0 | |
| 90447 | 4 | |
| 91501 | 6 | |
| 90358 | 5 | Third group |
| 91521 | 8 | of check figures. |
| 91990 | 8 | |
| 87000 | 5 | |
| 86500 | 9 | |
| 22463 | 7 | Fourth group |
| 32024 | 1 | of check figures. |
| 40304 | 1 | |
| 52628 | 3 | |
| 90346 | 2 | |
| 91501 | 6 | Fifth group |
| 91521 | 8 | of check figures. |
| 91990 | 8 | |
| 87000 | 5 | |
| 86500 | 9 | Sixth group |
| (b) 70639 | (5) | of check figures. |

Seventh group of check figures.

The figures comprising the first six check groups, are obtained by adding the horizontal columns and writing down the terminal figure of the sum thus obtained (i.e., $0 + 9 + 2 + 1 + 8 = 20$; check figure=0).

Similarly the seventh group is the terminal figures of each vertical column. The figure (5) of the sixth group is the "Key" figure. It is the terminal figure of the vertical column (*a*) of check figures and it must agree with the terminal figure obtained by adding the horizontal row (*b*). The key figure serves as a "check" on the check figures.

Now suppose an error of transmission (or reception) occurs in the group 19299 and instead of this, 19499 is received. The error is first detected on adding the horizontal columns, the check figure 2 not agreeing with that transmitted in the check group. Any one or more of the figures 1, 9, 4, 9, 9, might be wrong, but the error can usually be placed by adding the vertical columns and noting the disagreement with the figures of the seventh check group.

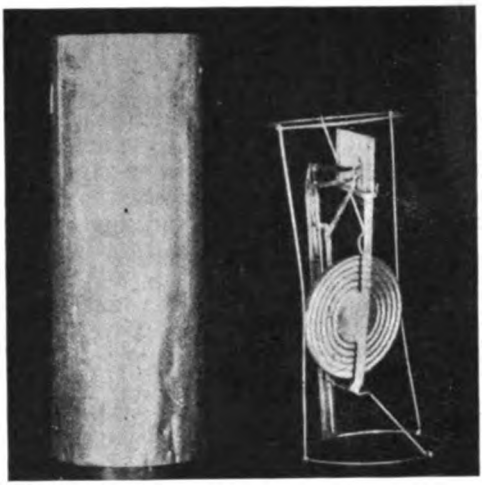

*Fig. 5. The ingenious recording meteorograph used for making temperature, barometer and humidity readings in the upper air. The whole apparatus weighs but a few ounces and is carried by a small balloon.*

## COMPLETE DECODE OF ABOVE MESSAGE.

Weather report based on obesrvations on Monday at 6 p.m. (18h. G.M.T.). Depression over the Baltic spreading East. Secondary depression off South-West Ireland. Forecast for 24 hours for Southern England—wind between S.W. and W., moderate or fresh, 27 m.p.h. at 2,000 feet from 240°. Mainly overcast at first with lowest cloud at a height of 1,000-2,000 feet, slight occasional rain, cloudy (cloud 2,000-3,000 feet) with passing showers later perhaps thunderstorms. Visibility good but slight local haze. Forecast for 24 hours for North England and South Scotland, wind between S.W. and W., light or moderate, 28 m.p.h. from 260° at 2,000 feet. Cloudy (lowest cloud 1,000-2,000 feet) varying irregularly in amount, slight occasional local rain or passing showers perhaps thunderstorms. Visibility good but slight local haze.

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# On the Amplification of High-Frequency Currents

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

*The general outline of the following article is based on a lecture delivered to the North London Wireless Association on January 30th, 1922, during which the apparatus referred to was demonstrated to the meeting.*

ALTHOUGH historically the use of a thermionic valve for the amplification of high-frequency currents was effected at least as early as it was used for a similar purpose in audio frequency circuits, this aspect of the whole subject of valve amplification has on the whole received much less attention by radio amateurs in this and other countries than has its use for low frequency or note magnification. There are doubtless many reasons contributing to this state of affairs, but it will suffice to refer here only to the most important of them.

In the first place the low frequency amplifier possesses, from the amateur's point of view, the great advantage that it can be used for signals of any wavelength. In many spheres of commercial radio work the receiver is called upon to function almost exclusively on one wavelength, or at least on a very narrow band of wavelengths, so that in such cases high frequency amplification, with the greater selectivity that it can be made to introduce, is not only practicable but very valuable; with the large wavelength range necessary to meet amateur and experimental requirements, however, the problem becomes more complex.

In the first place, therefore, I propose to make a few remarks about amplification in general, and then to deal rather more in detail with the particular problem of high frequency amplification over a large range of wavelengths.

It will be no use at the moment to refer to the other properties of valves, and to the construction of valves in general, but I would like, however, to draw your attention to the fact that the valve, that is the three-electrode valve as we all know it, in any of its forms is an amplifier in three distinct senses. It can be a voltage amplifier or a current amplifier as well as an energy amplifier, and to a certain extent one can choose in which form to utilise the output energy. In reality the valve is always an energy amplifier, because the energy in the output circuit is drawn practically entirely from the high tension battery, whereas the energy put in is not required to do more than to effect changes in the potential of the control electrode or grid. Fundamentally, therefore, the valve is an energy amplifier, but it is essentially a voltage operated device, since it has for its input circuit that joined to the grid or control electrode, which circuit is always of high resistance. We can, however, choose whether we take the output energy either in the form of voltage variations with small currents or current changes with smaller voltages. If we have a valve working under normal conditions, we apply, usually, the input energy in the form of voltage changes and require the output energy not in the form of current changes, but where we are concerned, as we usually are in receiving circuits, with the use of more than one valve in cascade for amplification, or where we require one valve for high magnification followed by another valve for detecting purposes, as the second valve in the case must be operated by voltage changes rather than by current changes, we require the output to be in the form of voltage changes. Hence, in all these cases which cover the essential requirements of most receivers both the input and output circuits of the valves are required to be arranged so as to deal with the energy in the form of voltage changes. It should not be forgotten, however, that the energy magnification is all important, as without it we should not gain anything by high-frequency amplification beyond what we could get by an ordinary high-frequency transformer, and when using note magnifiers to operate a loud-speaking telephone, it is the energy amplification which is vital. In the latter case we want the final output to be in the form of current changes instead of the voltage changes which are wanted at all the other stages of the amplifier. In this case the extra

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energy is required to bring into operation the large mass of the loud-speaking telephone, and where such loud-speaking telephones are required for producing sounds to be audible over large areas, this extra energy has to be obtained by using larger valves or more valves in parallel for the end stages of the amplifier. To fill a very large hall with sound by means of valve amplifiers and loud-speaking telephones it is not uncommon to use firstly ordinary valves and then two or more valves in parallel for the next stages, and then to pass that output energy on to a 5-watt transmitting valve or even to a 50 or a 100-watt valve so as to get in the final plate circuit very much larger energy changes.

For our purpose, where we are using the valve as an amplifier between the aerial (input) and the detector (output) circuits there is one factor of fundamental importance connected with all valves which gives us a measure of the effectiveness of the valve. The factor to which I refer is the voltage amplification factor of the valve. Primarily that factor is a constant of the actual physical construction of the valve rather than of the circuits used with it, but those circuits must be properly suited to the valve if the voltage factor of the valve is to be utilised to best advantage. The voltage factor of the valve represents the maximum possible voltage amplification that we can get with the valve in question by applying our initial energy (be it from an incoming signal or from a land-line telephone, or of any other form) to the grid circuit of the valve, and arranging the plate (output) circuit for maximum voltage changes. The effective amplification that we get in practice does not necessarily equal the maximum possible in the valve. In many cases it is far lower, and in practice the effective amplification is often a more important quantity to consider in high frequency than it is in low frequency amplification, since the former presents the greater difficulties.

The voltage factor is primarily connected with the characteristic curves of the valve, and its value can be deduced from these characteristic curves if we have the means of plotting out a series of such curves for the valve in use. Fig. 1 shows a series of four such curves connecting the anode current $I_a$ with the grid voltage $V_g$, for four different values of the anode voltage from the high-tension battery. Suppose we have our operating point at the position marked by C in Fig. 1, we have the voltage AC on the grid with current OX flowing from the high-tension battery, through the plate circuit of

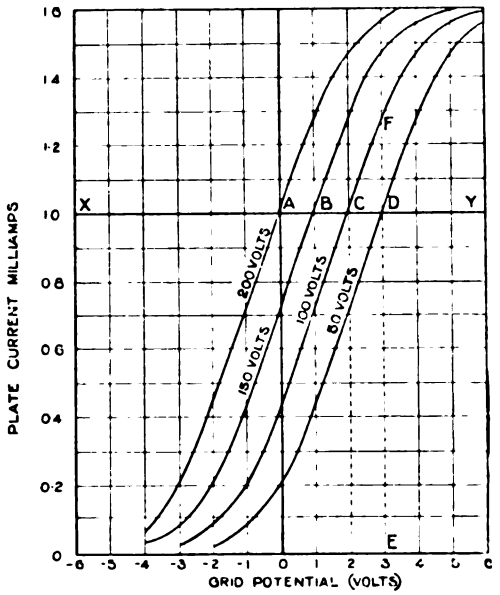


*Fig. 1. Valve Characteristic Curves to illustrate Voltage Factor.*

the valve. If we increase the grid voltage a small amount such as to OE the anode current will increase from ED to EF. The same would apply to whatever curves we take. We can bring the anode current down again to its initial value by reducing the voltage of the anode from the value corresponding to the curve passing through C to the value corresponding to the curve through D, and the ratio of the amount by which we must reduce the anode voltage when we increase the voltage of grid by a certain amount, the ratio of those voltages necessary to maintain the anode current constant is the voltage amplification factor of the valve. Hence, if we can draw out three or four characteristic curves we have the means of getting the maximum voltage amplification factor of the valve off those curves. In the case of the curves shown in Fig. 1 an increase of the grid voltage by 1 volt produces the same effect as a change of 50 volts on the anode—that is to say, the voltage amplification factor of the valve having the characteristics plotted in this figure is 50.

There are, however, two disadvantages attached to that method. Firstly, the plotting



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out of curves is rather laborious, and secondly, a number of costly instruments, milliammeters and high resistance voltmeters, etc., are required. There are, however, simple methods of measuring the voltage factor by means of a single operation; in other words it is possible to devise an instrument, such that if you plug your valve into it and make the necessary adjustments, it is possible to read off the voltage factor of the valve directly from a scale. The general principles of one such method I described recently in *The Wireless World**, but it may be of interest if I here briefly describe the arrangement as the measurement is one which is of fundamental importance. Figure 2 shows an instrument built up to operate upon this principle.

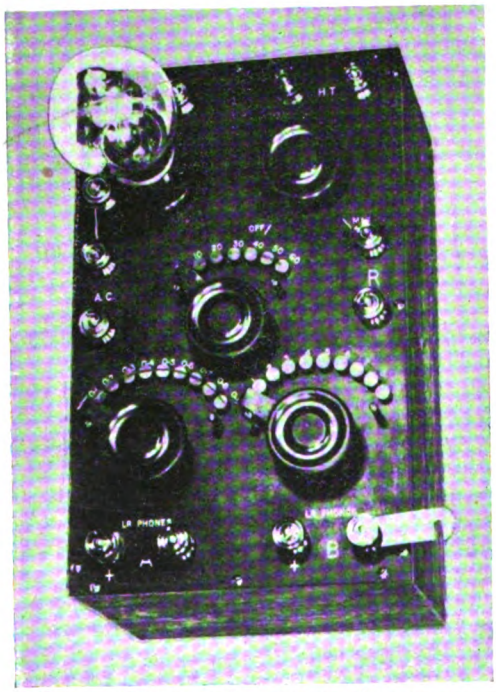

*Fig. 2. Photograph of voltage-factor meter.*

It has on top a holder for the valve, which is provided with the usual filament battery and filament resistance, and is connected up with a high-tension battery in its plate circuit, in series with a pair of telephones. The grid and anode circuits are also connected to the ends of a potentiometer, Fig. 3, the filament connection being taken to the slider. This potentiometer is also joined across some suitable source of audible frequency A.C. If we have it available, this may be a

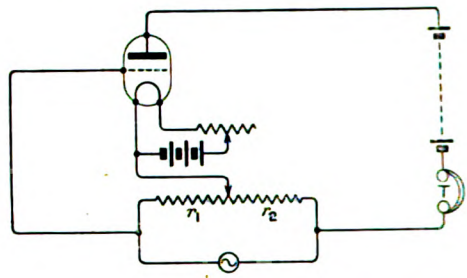


*Fig. 3. Connection of voltage-factor meter.*

300 or 400 cycle alternator, such as is often available in laboratories, but for private experimental purposes the use of a buzzer with a transformer is quite good. A little iron-cored telephone transformer with a buzzer and battery in series with its primary makes quite a useful arrangement for this purpose (Fig. 4). Alternatively a valve oscillating at an acoustic frequency can be employed, with the advantage that it gives a source of audible frequency of practically sine wave form and a pure note in the telephones. It has, however, the disadvantages that, firstly,

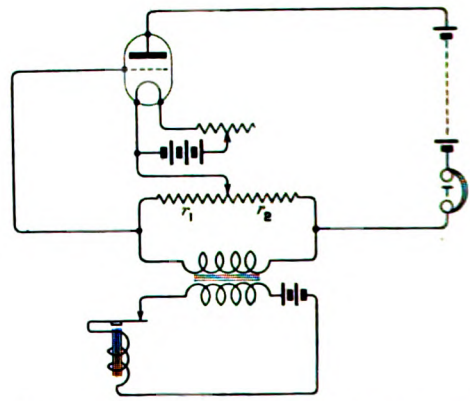


*Fig. 4. Connections of voltage-factor meter using Buzzer as A.C. source.*

if only one valve is used it is difficult to get sufficient energy from it to operate the set satisfactorily so as to get good signals in the telephones, and secondly, the transformer necessary to provide the retroaction to make

* *Wireless World*, 9 pp. 675–677, Feb. 4th, 1922.

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the valve oscillate at this frequency has generally a large stray magnetic field which often causes very serious errors. Similar remarks, however, apply to many arrangements of buzzer, so that in practical work the source of A.C. should be some distance away and connected to the instrument by two parallel wires close together. If we arrange the apparatus in this manner, light up the valve and put a suitable high tension battery in the plate

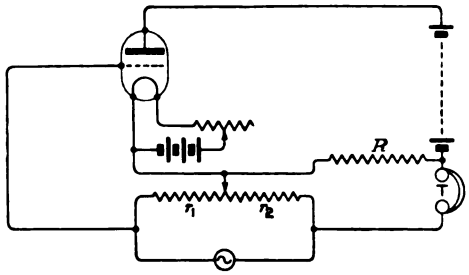


*Fig. 5. Connections of voltage-factor meter as arranged for measuring the internal resistance of the valve.*

circuit, a sound will be heard in the telephones due to the current flowing through them from the A.C. source. By adjusting the slider of the potentiometer (Fig. 3), a point will be found where the sound in the telephone practically disappears. If this is a uniformly wound potentiometer the ratio of the two lengths on each side of the slider is equal to the ratio of their resistances, and the voltage factor is given by the same ratio, viz., $r_2/r_1$. In the instrument shown (Fig. 2) I have made the resistance marked $r_1$ in Fig. 3 a fixed one of value 1 ohm and the point of connection of the filament to the resistances is also fixed, but I have the anode tapping point variable. This tapping point is marked so as to be direct reading to give the voltage amplification factor of the valve in use. The instrument can be used for lecture demonstration with a two-valve note magnifier and loud speaker to render the telephone sounds audible over the room.

Another constant of the valve, viz., its internal plate-filament resistance, can also be readily measured by this same apparatus. The circuit arrangement is slightly different, as an extra high resistance must be included in part of the anode circuit (Fig. 5). A resistance of the order of 20,000 to 50,000 ohms is suitable, and an ordinary type of anode resistance rod will work quite well. I have used this instrument on an anode resistance rod which is marked 50,000 ohms, but it is desirable to actually measure the value of the rod used on a Wheatstone bridge, as these resistances sometimes change and so render the marked values inaccurate. This particular resistance actually measures 68,000 ohms, although it is marked 50,000. By connecting this resistance on to two terminals provided for it when designing the instrument we get the desired connections for measuring the internal resistance of the valve. This constant of the valve is an important one, since for most efficient operation of the valve it is usually necessary to arrange the output circuit to have an impedance approximately equal to the internal resistance of the valve. The formula for calculating the resistance from the readings of the instrument is :

$$R_a = \frac{R(\nu r_1 - r_2)}{r_2}$$

where $\nu$ is the voltage amplification factor of the valve. In the instrument shown the resistances have been adjusted so that the formula simplifies to

$$R_a = R\left(\frac{S_1 - S_2}{S_2}\right)$$

where

$R_a$ = the internal resistance of the valve ;
$R$ = the large external resistance connected to the instrument ;
$r_1$ & $r_2$ = resistances marked with these symbols in Fig. 3 ;
$S_1$ = reading on scale of instrument when $R$ not connected ;
$S_2$ = reading on scale of instrument when $R$ is connected.

As an example of the measurement, a resistance of 20,000 ohms was connected to the terminals marked R on the instrument, and a new balance position for silence in the telephones was obtained at 2·7, the original reading before R was connected being 8·0. Hence, in this case the internal resistance of the valve $R_a = 20{,}000\left(\frac{8 - 2{\cdot}7}{2{\cdot}7}\right) = 40{,}000$ ohms approximately. If the temperature of the valve is altered, different values of this resistance $R_a$ will be obtained, so that you can by this method very easily take a series of resistance values at different temperatures, and at different high tension voltages or under almost any other desired conditions. Hence, by means of this instrument we can very easily determine two factors which are



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of great importance in connection with the use of the valve as an amplifier, whether for high or low frequency.

To pass on to the methods by which the voltage amplification of the valve can be utilised for the amplification of high frequency currents or rather for the amplification of high frequency energy, the most important thing to be considered is the coupling between the stages of the amplifier, and between the last high frequency valve and the detector. I have fitted up a circuit to arrange different ways of coupling the stages of the high frequency amplifier to show them in operation, and for this purpose I have a two-valve

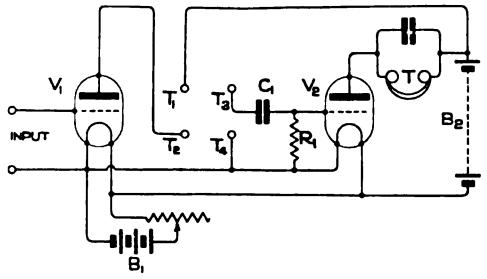


*Fig. 6. Connections of Experimental Amplifier Panel.*

arrangement provided with terminals to which various intervalve couplings can be connected. Incidentally it is a useful point to remember, in connection with the design of amplifying receivers for experimental work, that the valve holder and filament connections and the necessary leads to the high and low tension batteries can be mounted upon a board and kept quite distinct from all the rest of the apparatus. The coupling unit for use between any two valves can also be kept distinct, if desired, so that it becomes a simple matter to build up any type of amplifier. Fig. 6 indicates the scheme diagramatically. For simplicity two valves only are shown, with common anode and filament batteries $B_2$ and $B_1$ respectively for the two valves. The first is a high frequency valve, and the second one may be either another high frequency valve or a detector valve. The input is taken to the first grid and the filament as usual, and if $V_2$ is a detector valve we may have our telephones T in its plate circuit with the usual small bypass condenser. If we want to add any note-magnification stages, the coupling transformer will be put in place of the telephones. For the detector valve it is generally desirable to put a grid leak and condenser in its grid circuit, but rectification with a potentiometer can be arranged if preferred.

Any desired intervalve coupling unit can be connected into the four terminals marked $T_1$, $T_2$, $T_3$, $T_4$. For example, suppose we want to use a resistance-capacity coupling, the anode resistance should be inserted between $T_1$ and $T_2$, and the coupling condenser between $T_2$ and $T_3$, leaving $T_4$ free. In this case, the separate coupling condenser can evidently be suppressed, and the existing grid condenser (if of suitable capacity) can be used for the coupling. Again, suppose we wish to use a transformer coupling, all that is necessary is to connect the primary winding of the high-frequency intervalve transformer between $T_1$ and $T_2$, and its secondary between $T_3$ and $T_4$. Thus in a few minutes almost any one of the different types of intervalve coupling can be tested.

[Demonstration apparatus was arranged on the lecture table on these lines to show the operation of different types of intervalve coupling.]

I would now like to draw your attention to a method of coupling two valves which is probably the most direct that it is possible to have. The arrangement was, I believe, originally devised by A. Blondel, in France, as a means of coupling valves primarily for low frequency currents or for the amplification of small *direct* currents. As, however, the method

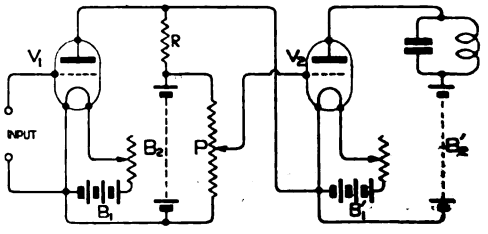


*Fig. 7. Circuit of Blondel's Amplifier with "Potentiometric" coupling.*

of coupling the valves directly gives a result which is practically independent of the frequency, apart from the effects of stray capacities, we can use the method for high frequency as well as for low. The arrangement is sketched in Fig. 7. In this diagram a resistance R is joined in the anode circuit of the first valve $V_1$, in series with the usual H.T. battery $B_2$. A potentiometer resistance P

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is shunted across the battery $B_2$ with its slider connected to the grid of the second valve $V_2$. The potential changes across R and the portion of P tapped off by the slider are therefore applied directly to the second valve. We can look on that circuit in another way by considering it as a Wheatstone bridge, as shown in Fig. 8. The ratio arms are made up of the two parts of the potentiometer marked $P_1$ and $P_2$ respectively. The other arms are made up of the fixed resistance R and the anode circuit of the valve $V_1$. The H.T. battery $B_2$ is joined across the ends of $P_1$ $P_2$ (as also shown in Fig. 7), the input circuit is connected to the grid of $V_1$, and the grid circuit of the second valve takes the place of the usual "galvanometer arm" of the bridge. By adjusting the slider of the potentiometer P (Fig. 7), *i.e.*, adjusting the ratio of $P_1$ to $P_2$ (Fig. 8), the bridge can be balanced, and there will then be no potential in the "galvanometer arm"

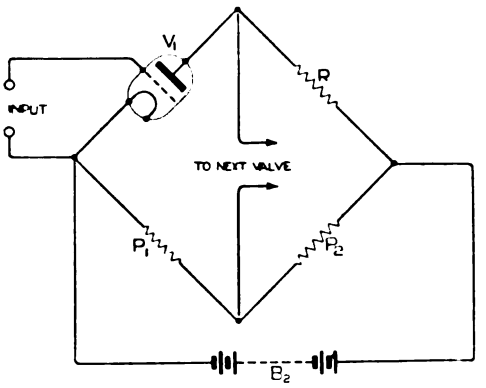


*Fig. 8. Bridge Amplifier Coupling.*

due to the bridge battery $B_2$—*i.e.*, under these conditions there will be no steady D.C. potential (from $B_2$) applied to the grid of the second valve.

The coupling between the valves is not in this arrangement affected by the frequency of current applied to it, because there is in the coupling no circuit of an oscillatory nature. There will, of course, be a limit to the amplification obtainable with such an arrangement, at the higher frequencies, on account of the capacities between the various parts of the circuit. Such stray capacities may cause an appreciable loss of amplification with very high-frequency currents, *i.e.* with wavelengths of the order of 150 to 200 metres, and on such wavelengths the problem of amplification becomes very much more difficult.

This direct coupling has the disadvantage of requiring two separate low-tension batteries and two separate high-tension batteries. The circuit sketched in Fig. 7 is the original scheme of Blondel's amplifier, but if we rearrange the circuit we can dispense with the use of two filament batteries. For this purpose we need merely to shift the resistance R to the other bridge arm and interchange the positions of the battery and galvanometer arms of the bridge, as shown in Fig. 9. The two valve filaments are then

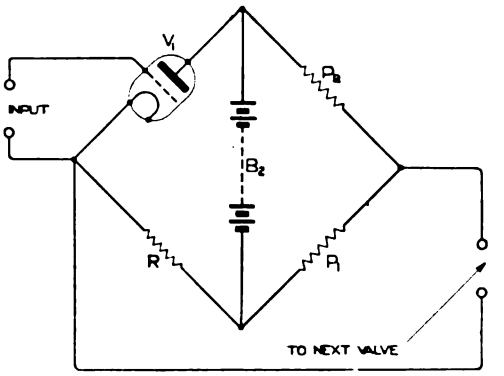


*Fig. 9. Modified Bridge Amplifier Coupling.*

joined together, and can therefore be fed from a common battery, as shown in Fig. 10.

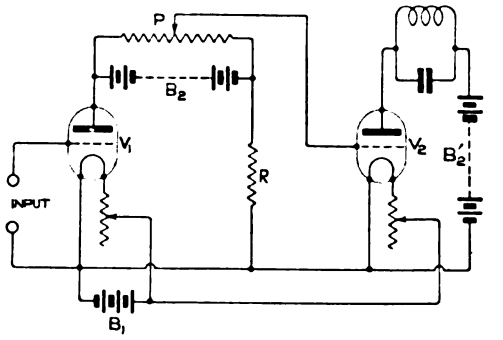


*Fig. 10. Simplified Blondel Amplifier using common L.T. Battery.*

This change, although two H.T. batteries are still required, is a simplification that enables the arrangement to be used for experimental purposes. The use of a common L.T. battery in this manner should reduce the stray

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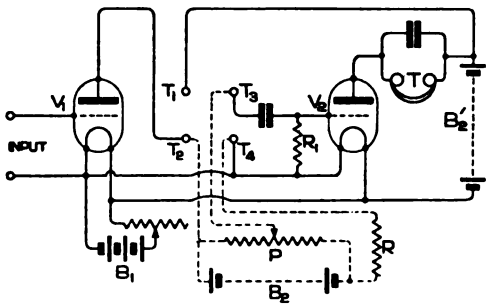


*Fig* 11. *Connections of Fig.* 10 *adapted to Experimental Amplifier Panel.*

capacities and enable the method to be employed for higher frequencies. This method can be adapted to the experimental amplifier panel outlined in Fig. 6, by leaving the terminal $T_1$ disconnected, and connecting a second H.T. battery and resistance R between $T_3$ and $T_4$ (Fig. 6). A potentiometer connected across the extra H.T. battery has its slider connected to terminal $T_3$, which is joined to the second valve $V_2$. These connections, adapted to the panel sketched in Fig. 6, are shown in Fig. 11.

(*To be concluded.*)

# Some Notes on the Transmissions from Writtle (2 MT).

By CAPTAIN P. P. ECKERSLEY.

## INTRODUCTION.

IT is the intention of this article to summarise the many reports on the Writtle transmissions, to give advice to the more amateur amateurs on a basis of really safe working, and to explain a little some of the difficulties at the transmitting end.

## THE BROAD PRINCIPLES OF WIRELESS TELEPHONY.

The basic principle of wireless telephony is the radiation of a continuous electromagnetic wave of frequency $n$, which has superimposed upon it much lower frequencies $p_1$, $p_2$, $p_3$, $p_n$, resulting in the final emission of a complex band of frequencies $n$, $n_1$, $n_2$, $n_3$ . . . . $n_n$.* The frequencies $n_1$, $n_2$, $n_3$ . . . $n_n$, are grouped about the "carrier wave" of frequency $n$. The state of affairs at any instant might be represented by the diagram shown in Fig. 1, which shows a bunch of resonance curves for the various frequencies $n$, $n_1$, $n_2$, $n_3$ . . . $n_n$. In the middle stands the carrier wave, and grouped about it are the side waves caused by the voice modulation.

When this complex disturbance arrives at a receiving system tuned to the frequency $n$ of the carrier wave, currents are set up in the receiving aerial proportional to the heights of the resonance curves of Fig. 1. It is the inter-heterodyning of the various frequencies which, when suitably detected, produce intelligible speech or music in the receiving apparatus.

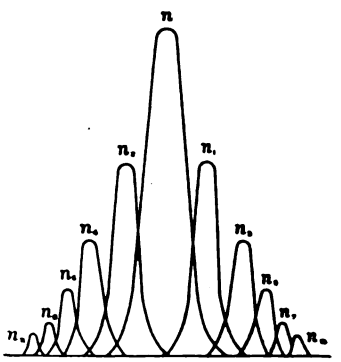


*Fig.* 1. *Resonance curves for various frequencies.*

## THE BEST ADJUSTMENT OF RECEIVING SYSTEMS.

It will be realised, therefore, that the adjustment of the receiver, apart from its arrangement, has a great influence on the quality of the received speech or music.

## REACTION.

Consider first the effect of reaction. If intensive reaction is used, it will be obvious that undue prominence will be given to the carrier wave and the lower frequencies, while the higher frequencies will be dwarfed to insignificance beside them. Many may have noticed how, if reaction is pushed to the limit, the mellowness of really good speech is lost, albeit the intensity is enormously increased. This applies especially to signals

* *Vide* Proc. Electrical Engineers. Vol. 58, No. 293, July, 1920, a paper on "Duplex Wireless Telephony," by the author. Appendix.

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which are initially weak and can only be detected by the furious use of reaction.

The best adjustment for getting really good quality (assuming, of course, a good transmitter, without which no good results can be obtained), is to use such magnification as to give a moderate signal without reaction, and to bring up to R.9 intensity by applying judicious reaction, but not to the oscillating threshold.

This is a counsel of perfection; it is realised that valves are expensive, high frequency magnification a pitfall in many hands, low tension batteries of big capacity are things of profit only to the local garage, and that many difficulties stand in the way of the enthusiastic but impecunious amateur.

It cannot too strongly be emphasised that the use of intensive reaction is wrong theoretically and morally. Many and many a good concert is spoilt for others by those unskilled and unscrupulous people who will use reaction circuits up to and beyond the reaction threshold, thereby causing squealing heterodyne notes in nearby receivers, and so completely spoiling other people's pleasure. Anyone purposely making their set oscillate will fail to get good results and will prevent the possibility of others getting good results. Even though a system is used where reaction is applied to a coupled circuit tuner, the system will still re-radiate if made to oscillate.

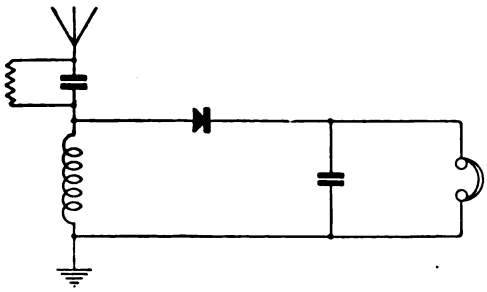

*Fig. 2. Circuit for plain aerial reception.*

## THE TUNER.

Consider again Fig. 1. It will be realised that sharpness of tuning has a tendency again to give undue prominence to the lower frequencies. If the signal is loud enough, therefore, better quality may be obtained by mistuning slightly. This will mean that only half of Fig. 1 will be received, but this gives perfectly good results in practice.

## SOME DISCUSSION ON THE ARRANGEMENT OF CIRCUITS.

Having suggested some general principles for the best adjustments, it might be helpful to many to discuss particular arrangements of receiving circuits.

It is extremely difficult to generalise on this subject because conditions are so very variable, one wants only to hear Writtle perhaps, and lives 100 miles away, another wants to receive any station between 15 and 25,000 metres, and lives 3,000 miles away from one station and 20 miles from another. It will be assumed, however (and it is trusted with some justification), that Writtle is the centre of attraction. To clarify the subject, let us take under appropriate headings, stations distant between 1 and 10 miles, 10 and 50 miles, 50 and 100 miles, 100 and 200 miles, and stations further than 200 miles.

Before starting, it is realised that the enthusiastic band of "one valvers" living sometimes 400 miles away will be shocked at the conservatism of the remarks, but this article is intended to give sound advice on something like a commercial basis for new amateurs who are not particularly skilled, and want to hear the concerts comfortably.

### STATIONS WITHIN 10 MILES. (Assuming a full P.M.G. aerial.)

Crystal or single valve every time. A crystal may give rather weak stuff at 10 miles, but there are several installations distanced 30 miles who have received our concerts very well—40 miles is about the record. The tuning circuits with a crystal need not be elaborate, because jamming will be non-existent. The great thing to be realised in crystal reception is that a crystal is a potential operated device, and that the inductance connected across it should be as large as possible. If plain aerial reception is used, as shown in Fig. 2, and it is desired to receive 400 metres, it is best to use a series condenser in order that the inductance may be made large. This, however, can be carried too far because the series condenser, if made too small, prejudices sensitivity, albeit the extra inductance enhances it. Thus the experimenter should choose a nice balance between the two variables.

It is better, of course, to use coupled circuit for crystal reception at short waves with a P.M.G. aerial, because the secondary circuit can be made of very large inductance with a correspondingly small condenser to tune it.

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While on the subject of receiving at close ranges, amateurs are warned very strongly against the prevalent disease of valveitis. By this is meant the use of too many valves for the given strength of signal without due precautions being taken. So often one hears of an installation with a full P.M.G. aerial direct coupled, four tuned high frequency magnifications, one detector and six note magnifiers (all R valves), and an ordinary ear piece thrust into a jam tin to make a loud speaker, station distant from Writtle 2½ statute miles. This is, of course, an exaggeration, but it indicates a frequently met with trend of development, which leads to the very worst results and gets " Broadcasting " a very bad name through no fault of those commercially interested. The use of too many valves always results in distortion, since saturation may easily be attained, or commoner, heavy grid currents clip off the tops of the intenser disturbances to the detriment of good quality. The question of loud speakers is a subject in itself. For the present it should be clearly understood that there is an intensity of signal which the usual receiving valve will not deal with properly, and there is a limit to the capabilities of the earpiece itself. The only excuse for using a lot of valves is when jamming at a different, but close, wavelength is likely to be experienced when very loose coupled tuners can be used. These will cut down sensitivity in proportion largely to their selectivity, and so the use of more amplification becomes necessary. Too great note magnification with iron transformers is a frequent source of trouble. Never use more than two note magnifiers and in general use only one. There is nothing so prejudicial to good quality as the usual design of note magnifier. So many amateurs seem to like signals to be extra loud and not to care a hang about quality. A robust receiving system with judicious reaction mistuned to give R6 signals is my ideal.

STATIONS BETWEEN 10 AND 50 MILES.

Full P.M.G. aerial. A single valve and reaction is probably the best arrangement up to 50 miles, but at the limit of range the addition of one note magnifier should make a simple, cheap and easily adjustable set. We have many and many a report of single valves being successful at 100 miles and more, but I cannot help feeling that the signals cannot be exactly loud, and that the adjustments must be critical, that the least jamming must spoil results, and that the sets may inadvertently slop into oscillation; the most selfish of sins in this broadcasting world. For real safe working at 50 miles then, a single valve might just do, but the addition of a note magnifier is certainly advisable. Jamming may begin to get troublesome at this range, but it is fundamental that if selective tuning circuits are to be used, the sensitivity must suffer. We have had reports of single valve reception at St. Austell, in Cornwall, and a few words have been heard on a single valve at the Forth Bridge.

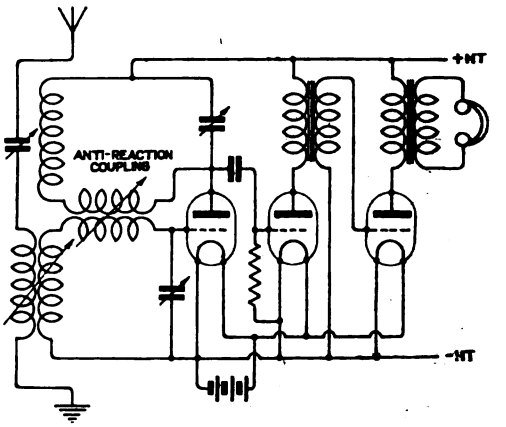


*Fig. 3. A suggested circuit for telephony reception.*

STATIONS BETWEEN 50 AND 100 MILES.

At 100 miles the difficulties are vastly multiplied. Jamming is the chief source of trouble, especially as many amateurs live at about 100 miles distance on the sea coast (say the Channel) and are keen on receiving Writtle, but are often prevented from getting results because of the interference from ship installations working in the narrow waters.

Coupled circuit is therefore advisable, and loose coupling should be used. To get good sensitivity the amplification must be fairly good. I suggest that tuned anode with one rectifier and one note magnifier is as good an arrangement as any, but great care will have to be taken to prevent the set from oscillating. It might be best to apply an anti-reaction arrangement between the tuned anode circuit and coupled circuit, this being *reduced* as more reaction is required. The basic diagram of connections is shown in Fig. 3. This is a typical circuit that would give good results. It is put forward as a suggestion, but there are plenty of other circuits that would do equally well probably. The idea of

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these remarks is to indicate the type of tuner and amount of amplification advisable.

STATIONS AT OVER 100 MILES DISTANCE.

For really good results high frequency amplification is advisable at this range. High frequency amplification may be done in all sorts of ways. It is a subject beset with pitfalls and "doctors disagree" on the question, so "'tis folly to be wise." My own impression is that for amateurs some form of tuned high frequency magnification is advisable, but beyond that I will not commit myself lest heated argument should arise.

SUMMING UP.

It may be said that the arrangment of the receiver must be chosen to suit the particular conditions under which reception is to take place. The usual tendency among amateurs is to use too little amplification at large ranges, and too much at short ranges, although the latter tendency is less marked than the first. It is very admirable to get results on single valves at long ranges, but the tendency for such sets to re-radiate is not in their favour, and the necessary small amplification gives little scope for using selective tuning.

With regard to the competition in connection with our transmission of August 15th, it has been somewhat difficult to choose the winners. One hundred and sixty replies were sent in, and the top marks came very close together.

After mature consideration, however, it has been decided to award the prizes as follows :—

| | |
|---|---|
| 1st prize | C. W Clarabut, The Bedford Physical and Radio Society. Beechcroft, Beverley Crescent, Bedford. |
| 2nd prize. | J. P. Beeson, Southwell, Notts. |
| 3rd prize. | C. G. Williams, 22, Scholar Street, Sefton Park, Liverpool. |

# A Portable Receiving Set

By A. LOVERING.

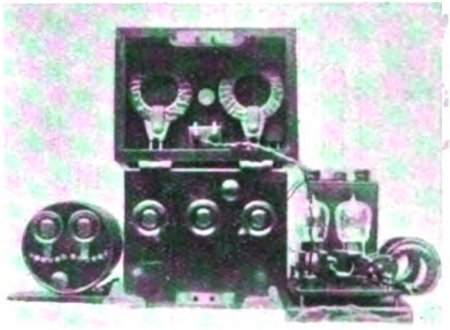
THE following description and accompanying photograph of a portable set which I have recently finished will perhaps be of interest to other readers.

The set is entirely self-contained, with the exception of the low tension battery. Two valves are used, the circuit being a standard two-valve low-frequency one. By using a flexible lead with a plug (coming from the transformer primary), one or two valves can be used as desired.

I think the photograph is more or less self-explanatory.

The two sides of the box are hinged at the bottom and the deep lid closes down over the knobs on the front panel. The centre knob is the filament resistance, and those on either side are primary and reactance tuning condensers respectively. The smaller knob immediately above is the main aerial circuit condenser. Shunted with this is the smaller one already mentioned, which is used for the more critical adjustments, the total capacity of the two being about 0·0013 mfd.

All three condensers are sliding, the problem of "space" being always uppermost. The two smaller ones are operated from the knobs by cranks, this giving fairly sensitive adjustment. Besides having the coil holders, transformer, and an "off" switch for the second valve, the panel on the right is fitted with a series-parallel switch for the A.T. condenser.



*Photograph of the Portable Set.*

For waves above 2,000 metres I use a set of five slabs, taped and fitted plug mountings. By using either one or two coils in the aerial circuit, and by working either series or parallel condenser as the case may be, I have practically a complete range of wavelengths up to 26,000 metres.

The loose coupled tuner on left is used for waves below 2,000 metres. I can get down to approximately 4,000 metres on this.

The 30-volt H.T. unit is accommodated in the lid, likewise the two larger coils. Of course, telephones are taken from headbands to facilitate packing.

The set was primarily designed for long range work, and by testing out in progressive stages of making, I have arrived at fairly good results. I originally intended having an H.F. transformer for the short waves, but space would not permit.

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# A Universal Unit System

By 2 CM.

THE Unit system is almost essential to the experimenter who is limited as regards time and money. It avoids the continual scrapping and reconstruction of apparatus, and provided it is properly designed, it enables almost any circuit to be tried without complex switching.

The system described in this article has been designed not only to be universal, but also to be simple of construction. It requires

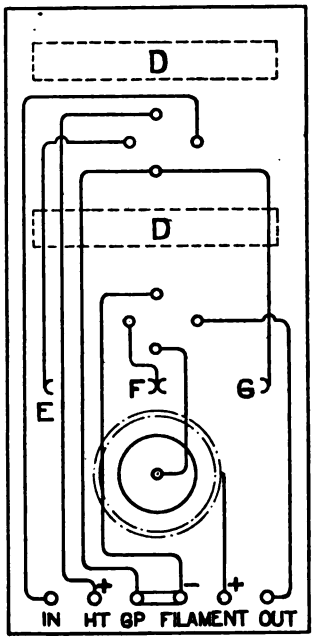


*Fig. 1. The Main Valve Unit.*

no elaborate woodwork or boxmaking, and may be made either in ebonite or hard wood. The latter is quite satisfactory for wireless reception purposes, provided it is well dried and varnished.

The main valve unit is shown in Fig. 1, and is simply duplicated for any number of valves. It consists of a baseboard, resting on two strips of wood ($\frac{3}{4}$ in. deep) at the back and front, thus giving space underneath for all the permanent wiring and the filament resistance. The front valve holder is for the valve, while that at the back of the unit takes the intervalve pass-on. This may consist of a high frequency transformer, as shown in Fig. 2 at *A*; a resistance-capacity as *B*, or an iron core intervalve transformer as *C*. Two battens *D* (shown dotted in Fig. 1)) are screwed to the base to support this transformer, which is mounted on wood and may be boxed in with a wooden or sheet metal cover if desired, the prong-plug being on the underside of the transformer platform.

Clips *E*, *F* and *G* are for the purpose of introducing a grid condenser and leak if it is desired to detect on the particular valve, the combined condenser and leak being clipped between *E* and *F*, or, if leakage is desired direct to the filament negative (or to a potentiometer, via terminal *GP*), the condenser alone is put between *E* and *F* and the leak between

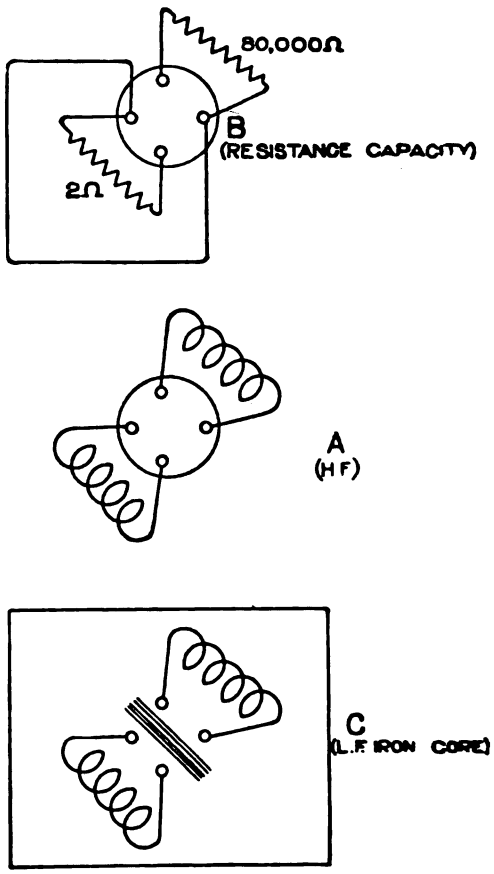


*Fig. 2. Showing interchangeable couplings.*

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*F* and *G*. Normally, when the valve is acting as an amplifier, clips *E* and *F* are shorted by a metal bar put in in place of condenser.

The terminal *GP* on the valve unit, which is normally bridged to filament negative, is for the purpose of controlling the grids if it is desired to put a negative potential on them when using a high voltage on the plates, or for separate control when the valve is in use as a detector.

are required. The primary tuning and secondary tuning inductances *K* and *L* are normally close together, but units may be separated if coupling is found to be too tight when using more than one H.F. valve between. Low frequency valves are put in by switching on their filaments and putting switch *M* to an appropriate position. Thus any number of valves may be used without disturbing the wiring of the set.

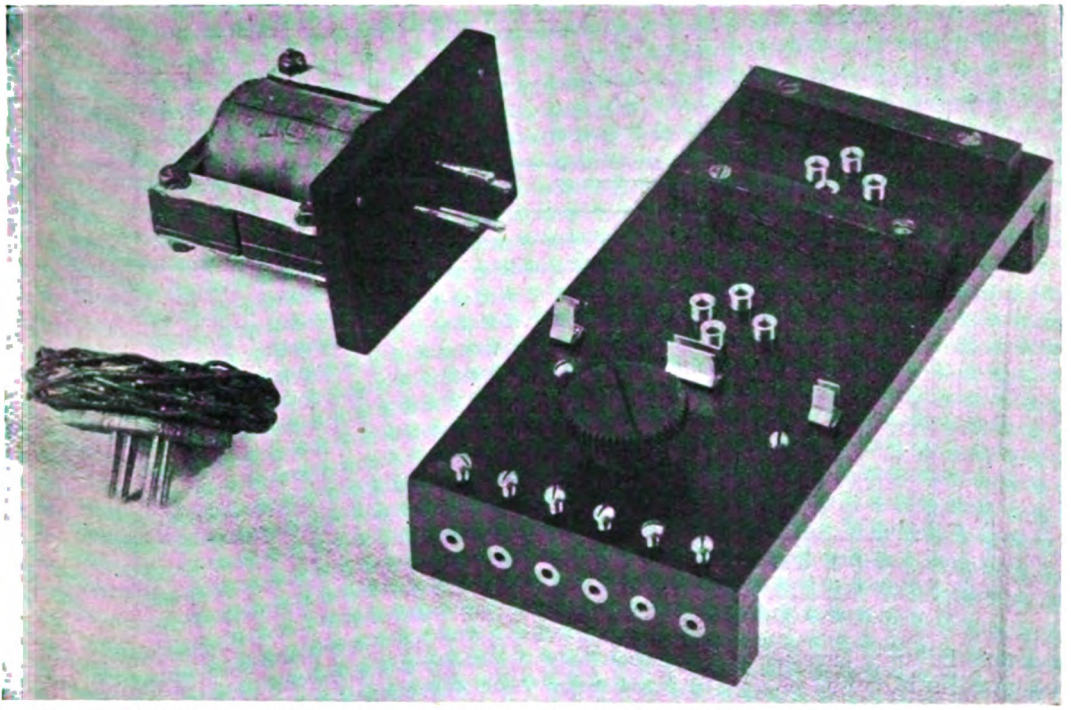

*Fig. 3. Showing the main unit. It will be seen that the terminals consist of ¼ in. brass rod, drilled ⅛ in. and let into the front of the unit. An ⅛ in. Whit. screw is tapped into the side of the tube to grip the wire, the head coming through the top of the unit. This construction saves a great deal of space, and enables prong plugs to be used if desired for connections. The photograph also shows the Iron Core Transformer (cover removed) mounted for plugging in, and a high frequency pass-on which is used alternatively.*

The complete arrangement is shown in Fig. 4. It will be seen that the units requiring adjustment are placed to the front of the table, while the valve units are out of the way at the rear. This arrangement enables adjustment to be easily made and also allows of the circuit being easily changed as occasion demands.

The arrangement shown gives two valves, high frequency, crystal detection, and three valves low frequency. The plug *H* is plugged in in the place of transformer at *I* or *J*, depending on whether one or two H.F. valves

If it is desired to utilise more units for high frequency it is only necessary to bridge terminals " in " and " out " at *N* and transfer leads *O* and *P* to one of the corresponding positions to the right.

For valve with grid condenser detection, the high tension battery is disconnected from the secondary tuning unit and the lead *Q* transferred from " out " to " H.T.+," thus giving the standard circuit for the purpose. The crystal point is, of course, taken off and, if if the high tension positive is connected to

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terminal " Out," the blocking condenser will be connected across the primary of the first intervalve transformer.

Many other connections are possible and will easily be arranged as occasion arises.

may be spaced to any desired degree if reaction is troublesome. " Dis " transformers may be instantly replaced with others or with resistance-capacities, which when demonstrating, is an important point.

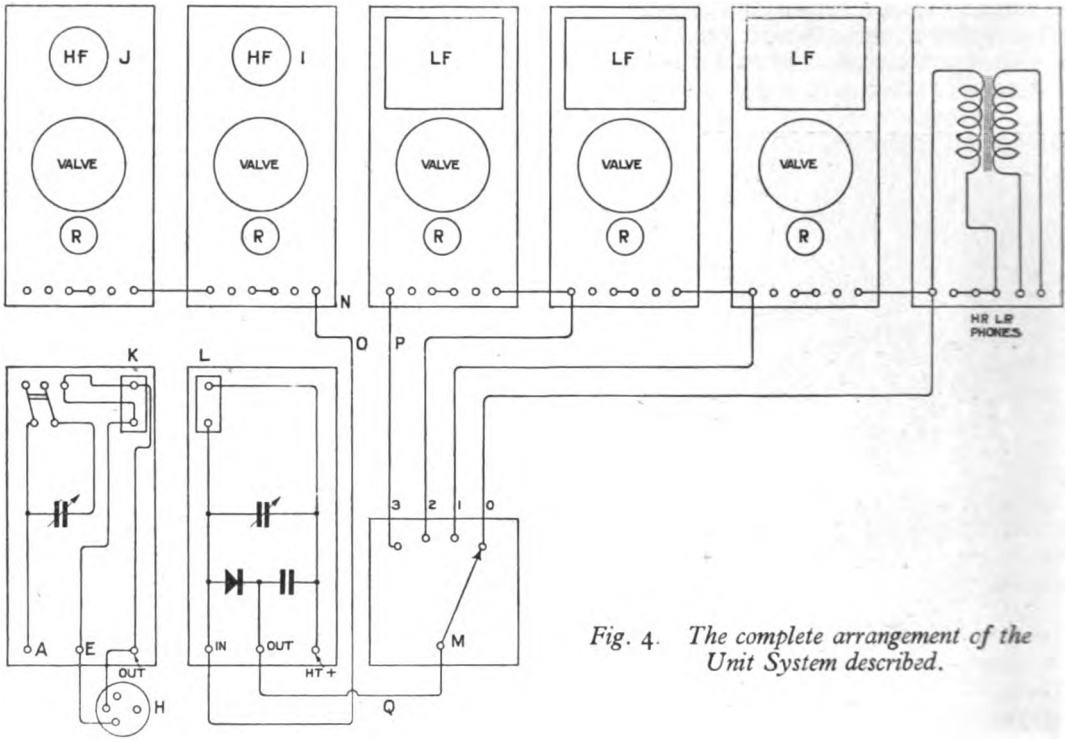


*Fig. 4. The complete arrangement of the Unit System described.*

Once the units have been made, they may be boxed in if desired or may be made up in any convenient form (either vertically or horizontally) as they take practically no more space than any similar multivalve amplifier. They have the additional advantage that they

In addition to being a great convenience to the advanced worker, this system will enable the beginner to extend his apparatus as funds permit, and will necessitate no remaking as he advances towards his "*n*th" valve amplifier.

DO NOT FORGET THESE DATES!

**SEPTEMBER 30th TO OCTOBER 7th, 1922**

**The All-British Wireless Exhibition & Convention**

AT THE HORTICULTURAL HALL

WESTMINSTER, S.W.

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# Development of Radio Broadcasting in the United States

By M. B. SLEEPER.

*The author of the following article, Mr. M. B. Sleeper, is so well-known amongst amateur circles in America, that it is felt that the following account of the development of Broadcasting in America cannot but prove of special interest at the present time, coming from one who has watched the growth in the popularity of wireless from inside. Mr. Sleeper has just returned to America from a visit to this country.*

ALTHOUGH Radio Telephone Broadcasting was conducted with a regular daily and nightly programme from the Westinghouse station at Pittsburgh, Pa., for many months prior to the summer of 1921, the interest in broadcast reception was only felt locally. Almost a year ago, experimenters, particularly in the New England States and New York, suddenly awoke to the fact that the centre of radio had formed around Pittsburgh, and an investigation of radio manufacturers' sales revealed that quietly, under the stimulus of radio telephony, that section had outstripped all others in receiving sets *per capita*.

Right at that time the Dempsey-Carpentier bout was held in New Jersey. Without any public announcements the Westinghouse Company had erected and perfected the operation of a ½-kW. telephone set at Newark, New Jersey, just across the Hudson River from New York. Just before the contest was to take place, notice was given that the fight returns would be broadcasted, blow by blow, from Newark, now so widely known as WJZ.

It was a most appropriate time to catch the attention of the public, for interest in the bout was keen. In public places and private homes thousands of people were intensely thrilled by the reception of each detail, given out by radio, even to the ringing of the gong and the applause of the spectators.

New York, acting characteristically as a distributing centre, sent out the news of this achievement far and wide through the mediums of the newspapers and travellers from other cities who witnessed, or rather heard, the demonstration. At that time, too, WJZ took up the reporting of baseball games and, later, football. Facilities of the *Newark Call* newspaper were made available to the operator, who despatched by radio résumés of press reports. Then a daily programme was adopted. Music was sent out each hour on the hour, starting at 10.0 a.m. In the evening a special entertainment, starting in the bed-time stories for the children and ending with music or singing by the best known artists, was scheduled.

The radio business, always slow between June 1st and September 1st, started up with a jump. Before the dealers knew what had happened their shelves were empty. Insistent demands for broadcasting stations came from all sides, but no company was prepared to turn out heavy duty equipment. Then, as always, the experimenters set to work. In different cities all kinds and types of transmitters were erected for radio shops, department stores, newspapers, furniture stores, and similar companies. Anything that would speak was called a broadcasting station.

By Christmas there was no such thing as a rush order, or perhaps it should be said that all were rush orders. In January it almost seemed that only through personal friendship with the manufacturers could dealers get supplies. February brought offers of premium prices. And so it went.

The first real radio show was held at New York City in March, 1922. Instead of the scattered attendance of 1921, thousands of people came to learn of this new wonder. Thousands, too, were unable to obtain admission. Radio companies were formed all over the country, dozens of them every week. Magazines sprouted on the news-stands like mushrooms. nnouncements of radio shows in other cities followed in quick succession. At electrical stores where, six months back, the buyers had refused to talk with radio salesmen, established wireless departments which in many cases exceeded in volume all

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their other business. It became quite the usual thing to sell £200 worth of apparatus a day over the counter. Equipment appeared in the windows of drug stores, hardware stores, millinery and tailor shops, seed stores, pawnshops, and, of course, department stores took it up. Some enterprising radio companies arranged to stock and operate radio sections in department stores, paying 10 per cent. for the space and accommodations. They had the special advantage of being able to get the supplies.

During this time conditions in the air became badly muddled. Those who were interested in hearing the broadcasting complained that different telephone stations interfered with each other, or were interfered with by experimenters on 200 metres and commercial stations at 600 metres and above. Others carrying on long distance or DX transmission and relay work at 200 metres complained that telephone stations made their work impossible.

Before long however, by Government regulation through the Department of Commerce, which controls radio as the Post Office does in England, and the co-operation of radio clubs, particularly those affiliated in the American Radio Relay League, the difficulties became quite well adjusted. Between Messrs. Warner and Schnell, Editor of *Q.S.T.* and Traffic Manager of the A.R.R.L., respectively, the experimenters were made to realise that they could not interfere in the legitimate broadcasting if they did not respect the rights of the telephone on the air. Since telephone stations generally close down by 10 p.m., sufficient time is left for the "Boiled Owls" to carry on their DX work. Then came the arranging of broadcasting schedules, with the result that one station follows another all day and all evening, thus replacing with continual entertainment the irregular interference of the spring. These schedules are planned in cities where two to six broadcasting stations are in operation.

The expense of broadcasting too, has worked itself out. Obviously it would be too great an undertaking for one company to operate any number of stations. Such expense must be borne by the individual company and charged off as advertising, as there is no Government support. Neither is there a charge for transmitting licences. No receiving licence or regulations are imposed. Consequently the Western Electric Company, by agreement with Westinghouse and General Electric, the only concern building telephone transmitters under full patent protection, has and is making sets to sell to such companies as can afford to carry a broadcasting station in their advertising appropriations. In that way those corporations profit by the sale of the sets, and reap a double profit through the sale of apparatus to experimenters.

Perhaps the greatest hardship to the public and the legitimate companies are the "boot-leg" manufacturers who, seeing a chance to profit by the under-production of equipment, copied various standard advertised instruments and cut the prices. That situation has largely taken care of itself. The dealers, anxious to get goods about the time the boot-leggers were showing samples, ordered far and wide, assuming that deliveries would be slow. Those concerns got into full production about May, just before buying stopped for the summer months of June, July and August. Right at that time dealers cancelled all their orders except those placed with reputable companies, whose goodwill they will need this fall. The boot-leggers were thus caught with big stocks and no market, bills to pay and no accounts to collect. As a result they went out of business by the dozen in all parts of the country.

Here, then, you have a sketch of broadcasting and developments from it, viewed by the public and the manufacturer. If there is here a suggestion or two for the English radio man, I shall feel that I have to a small degree repaid those who have made my stay in England so pleasant and interesting.

# Notes.

**The Radio Club d'Algerie.**

The Secretary of the above Club, Mr. A. Moisan, Boulevard Carnot, Algiers, will be pleased to receive communications from British amateur societies. His Club is at present interesting itself in particular in problems of static interference. It is proposed to publish a journal of the Society next October.

**Society Formed at London County Hall**

As the result of a meeting held at the new County Hall, a wireless society has been formed which is seeking affiliation with the Wireless Society of London. Mr. S. E. MacKeown has been elected President, and the Hon. Secretary is Mr. H W. Fuller. The membership comprises those members of the L.C.C. staff at the County Hall who are interested in wireless matters. The Society meets monthly in Room 38 on the first Tuesday, at 5.30 p.m.

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### Edinburgh Society's New Station.

A transmitting station, 2FT, has been equipped by the Edinburgh and District Radio Society. C.W. and telephony transmissions are conducted on 150-200-440 metres.

### Herschel Centenary.

On August 25th, at Slough, the centenary of the death of Sir William Herschel was commemorated. As first President of the Royal Astronomical Society and a great scientist he is remembered with profound respect by all.

### Weather Reports for Canadian Farmers.

Broadcasted weather reports are to be furnished by the United Farmers of Ontario for the benefit of farmers generally. Transmission will be effected from the headquarters in Toronto. Market reports will also be sent out in this way.

### Broadcasting from Arlington for U.S. Shipping Board Vessels.

It is announced that Arlington (NAA), immediately after broadcasting the time signal, will give the call letters of all ships for which Arlington has traffic, and, at the conclusion of the broadcasting schedule, will broadcast messages for those vessels previously designated.

### Saint Assise in Operation.

Trouble in Ireland has affected cables to America and the result is pressure on the French-American communications. Saint Assise is reported to have risen to the occasion by speeding up to full working order and transmitting a million words a day.

### A High Power Station Wanted.

Tristan da Cunha, a British possession in the South Atlantic, is 1,700 miles from the nearest inhabited land, and is in need of an installation which will place the island with its 120 or so inhabitants in communication with the outside world. This lonely spot is midway between Cape Horn and the Cape of Good Hope, A receiving set has been given by the South African people, and meteorological equipment has been introduced, but no means of transmission is as yet available. A system of communication across the South Atlantic, using Tristan da Cunha as a link station, would overcome the islands difficulty, but the cost would hardly justify the experiment, unless some further purpose could be served by the station.

### British Association Meeting. September 6th to 13th, 1922.

During the meeting of the British Association this year, a temporary branch of the Meteorological Office, Air Ministry, will be opened at the Guildhall, Hull. Synoptic weather charts will be prepared daily and exhibited, together with forecasts based on them, on a large specially constructed blackboard in the Reception Room of the Association. In addition a "Local Daily Weather Report," containing the morning's synoptic chart with forecasts and local weather information, will be duplicated, and copies posted in the various buildings occupied by the Association and in certain prominent places in the City.

These reports will be prepared solely from data contained in the routine weather messages issued broadcast daily by wireless telegraphy in Great Britain and other European countries. For the reception of these messages an ordinary standard receiver will be installed consisting of a single rectifying valve and two low frequency amplifying valves with variometer tuning circuits. Members of the Association will be admitted to the room in which the messages are received and will be able to see the whole process of reception, decoding, construction of weather charts and preparation of forecasts.

It is hoped that this demonstration will be of assistance to many who may wish to receive this up-to-date weather information, either through interest alone or for its practical use or in the case of Colleges, Schools, etc., for educational value.

### Exhibition at the Central Hall, Westminster.

A wireless exhibition was opened on Saturday, September 2nd, at the Central Hall, Westminster. The exhibition closes on September 8th.

The exhibits include wireless apparatus and parts, whilst a considerable number of wholesale suppliers of wireless accessories are represented.

Competitions are being run in connection with the exhibition, one of which consists in attempting to solve a crime by means of wireless, and another is a competition in operating speed.

The organisers of this exhibition are Messrs. Dale, Reynolds & Co., Ltd., of 46, Cannon Street, E.C.4., who are to be congratulated on the large attendance which the exhibition is drawing.

## Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to Mr. Harris's article entitled "Wireless Without an Aerial," which appears in the August 26th issue of *The Wireless World and Radio Review*, the attention of experimenters should be drawn to the danger arising from using ordinary types of aerial condensers in the manner there described. Many of the ordinary patterns of variable air condensers have short-circuit positions at one or both ends of the scale, so that a dead short circuit of the supply mains might easily occur if the condensers are not handled carefully. Small specks of dust on the condenser plates are also liable to cause a flash over on 200 volts circuits. The only safe way of experimenting in this direction is to employ condensers properly designed for this use, and having high insulation resistance. Fixed condensers can be used in lieu of two of the variables described, leaving the tuning to be effected by the series condenser in the ordinary way.

PHILIP R. COURSEY,
*Chief Engineer, Dubilier Condenser Co., Ltd*

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—As one greatly interested in the wireless telephony movement so prominently before the public at the present time, I am anxious, before installing one of the many receiving apparatus now on the market, to know somewhat definitely the prospects of the wireless telephony service in the immediate future.

I have made inquiries of several manufacturers of and retail dealers in wireless telephone receiving

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apparatus, and I have read a good many paragraphs in the daily press on the subject. The net result I have arrived at is that in return for a considerable outlay on the purchase of apparatus, erection of aerials, etc., I may have the great privilege of hearing nightly concerts, bed-time tales—whatever they may be—occasional lectures on subjects of interest (to whom?) and on Sunday sermons of an undenominational nature not likely to cause offence to any religious sect. No prospects of receiving any news of real interest such as important foreign and home news, election results, parliamentary news, stock market closing prices, foreign exchange rates, racing or other sporting results, is even hinted at; in fact, in one instance, I was told (with what amount of accuracy I do not know) that broadcasting centres were definitely pledged not to distribute anything in the nature of daily news. This reduces wireless telephony receiving apparatus to the level of an ingenious toy somewhat inferior to the gramophone, and I, for one, am certainly not inclined to incur the expense of £100—the amount of the estimate for installing the wireless telephony receiving apparatus in my country house—for the very doubtful privileges offered. I do not care for indifferent music; the lectures I prefer to read (or not) in my daily or weekly paper; and even the inoffensive sermon does not strongly appeal to me.

Surely an epoch-making invention such as wireless telephony can be put to more useful purpose and have a greater commercial utility. Why not make it a means of rapidly disseminating real news, or would this infringe the vested interest of the press, such as the introduction of the railway locomotive did to the mail coach business, or the reaping machine to the agricultural industry some time ago?

ENQUIRER.

[The question of the broadcasting of news items, etc., is one which we understand the Government now has under consideration, and the decision which will be arrived at will no doubt depend largely upon the attitude of the press.

The cost of installation of a wireless receiving station, as quoted by Enquirer, does not seem to us to be a reasonable average estimate.—ED.]

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In recent issues of your paper you have published letters from various amateurs reporting successful reception, but in nearly every case you fail to give an idea of the location of the station.

For instance, in last issue you publish a letter from an amateur who receives Croydon without H.F. amplification. If this gentleman is up North here (except Aberdeen) it is very good reception, but if he should be down in the Midlands it is nothing to shout about.

A short time ago a correspondent reported good reception of the Halifax telephony. Our heads went up in the air for about a week until we found that we could have reached the man with a decent sized megaphone, he only being a short distance away.

If your correspondents do not wish to have their addresses published, at least the town could be inserted. To those of us who specialise in long distance reception it is not much use to read of an amateur hearing **2KD, 2GU,** or **2YF,** if there is no indication as to whether he is 10 or 100 miles away.

I should like to raise another point on which I have written you before, and that is, to ask amateurs transmitting to say who they are. Up North here on changing over we always start "Hello **2AB, 2CD** replying ..... **2CD**over."

Down South of us, the practice seems to be "Hello, old bean, your speech is **O.K.** changing over," and "Well, I'm shutting down now, call you up to-morrow," giving no indication as to whether the experimenter is transmitting well, 100 miles away, or badly, 10 miles away.

A few Sundays ago I heard a magnificent musical programme on about 950 metres. At the conclusion a request was made that listeners-in would send reports as to reception, but during the whole 35 minutes of the programme there was never the slightest indication given as to who the experimenter was.

By the way, is there any hope that the P.M.G. will prohibit the use of reaction to the "ether abusers." We could equip a splendid drum and fife band in Halifax and district.

LOUIS J. WOOD, *Hon. Secretary,*
Halifax Wireless Club.

# Book Received

RADIO RECEIVING FOR BEGINNERS. By Rhery T. Snodgrass and Victor F. Camp, London: *Macmillan and Co.* Pp. 100 7¾″ × 5¼″.)

# Calendar of Current Events

**Friday, September 8th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Lecture on "Automatic Telephony," by Mr. H. Mortimer.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.

8 *p.m.*—At Erith Technical Institute, General Meeting and enrolment of members.

RADIO EXHIBITION AND WIRELESS CONVENTION, CENTRAL HALL, WESTMINSTER.

(*Last Day of Exhibition*).

**Sunday, September 10th.**

*Daily Mail* concert from the Hague (**PCGG**) 8 to 9 p.m. B.S.T., on 1,085 metres.

**Monday, September 11th.**

HORNSEY AND DISTRICT WIRELESS SOCIETY. Lecture on "Practical Construction of an Amateur Receiving Station." By H. Davy.

**Tuesday, September 12th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT** (Writtle).

**Thursday, September 14th.**

*Daily Mail* Concert, 8 to 9 p.m. (as above).

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Wireless Society of London.

The New Session of the above Society is about to commence, and announcements will appear in due course.

Applications for affiliation or for membership should be addressed now to the Hon. Secretary, Mr. L. H. McMichael, 32, Quex Road, N.W.6.

### Stoke-on-Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of this Society on Thursday, August 24th, it was announced that permission to utilise the mast over the "Dew Drop" Inn to support the free end of the aerial had been refused by Messrs. Worthington. A fresh scheme is being devised, and this is being left in the hands of the Technical Committee..

An interesting discussion took place on several points raised by some of the newer members concerning the working of their apparatus.

The proposed Exhibition which the Society hopes to hold in Hanley at the end of the year or the beginning of the new year was discussed, and enquiries are now being made to find a suitable hall in which it can be held.

An interesting programme is being drawn up for the next few weeks. A demonstration was held a few days ago with the aid of an indoor aerial and the Society's three-valve set.

### Wolverhampton and District Wireless Society.*

A meeting of the above Society was held at Headquarters, 26, King Street, Wolverhampton, on Wednesday, August 23rd, when a lecture was given by Mr. D. P. Baker on "Tape Recording by Wireless."

The lecturer dealt very ably and lucidly with the subject, explaining the necessity for rectification and the use of two relays to operate the inker, also demonstrating with the actual apparatus and with diagrams. It was evident the lecturer had had considerable experience in recording. The meeting was well attended, and the members present were greatly interested. It is hoped to secure the services of Mr. Baker again at an early date.

The resignation of the Secretary, Mr. G. W. Jones, was tendered and received with regret, Mr. Jones feeling reluctantly compelled to relinquish the secretarial duties owing to pressure of business. The meeting passed a very hearty vote of thanks to Mr. Jones for his past services, special reference being made to his work as one of the founders of the Society.

The newly appointed Secretary is Mr. J. A. H. Devey, 232, Gt. Brickkiln Street, Wolverhampton, who would be glad if correspondents would kindly note.

### Wireless and Experimental Association.*

On Wednesday, August 23rd, The Wireless and Experimental Association, at the Central Hall, Peckham, had the pleasure of listening to a very interesting and instructive lecture by Mr. F. H. Haynes, on the Johnsen Rahbek Loud Speaker. Starting from the very beginning, the lecturer went through every point of the construction of the apparatus, giving enough of the theory to enable his listeners to appreciate the various parts and their uses.

Full instructions were given to enable one to cut and polish their own agate cylinders—if they had the right sort of agate. The necessity for a polarising battery to make the apparatus sensitive to weak signals was well brought out.

The Association's installation engineer was unfortunately not present, and the wireless receiving set not available for purposes of demonstration of the capabilities of the loud speaker, but a couple of orators and a songster in another room made up a scratch broadcasting programme, though they did not tell the tale of the stuffed dog.

The lecturer afterwards demonstrated the use of the Neon tube as a generator of oscillations, and more than one present had an idea that it might be very useful in the installation of an Armstrong receiving circuit.

The meeting closed with a cordial vote of thanks to the lecturer.

Hon. Secretary, Mr. G. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

### North Middlesex Wireless Club.*

The 97th meeting of the Club was held on Wednesday, August 23rd, at Shaftesbury Hall, Bowes Park. Before the meeting was formally opened, Mr. Holton gave a lecture to the more elementary members who had assembled on the subject of aerial construction. He explained the reasons for the different types of aerials, and showed why the single wire type was to be preferred for receiving short waves, although the two-wire type was better for longer waves. Mr. Holton answered many questions put to him and cleared up several knotty points.

The meeting was then formally opened by the Chairman taking the chair at 8.30, and calling on Mr. A. J. Dixon for his talk "Commercial Wireless Instruments and How they Work." Mr. Dixon explained the principles on which the Magnavox, the Brown loud speaker, the Brown head receiver, and several other well-known instruments work. The Chairman, Mr. Evans, also contributed to the evenings discussion, and the meeting closed by a vote of thanks moved by the Chairman to Mr. Dixon.

Several new members were enrolled, and the



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Librarian was kept busy attending to the demands of members for books.

Particulars of the Club may be obtained from the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, N.21.

### The East London Radio Society.*

A very successful and well attended meeting was held in the Society's lecture hall in Woodstock Road, on Tuesday, August 22nd, 1922, at 7.30 p.m.

The meeting opened with the usual buzzer practice.

Mr. J. Lipowsky lectured upon the construction of a cheap and efficient loud speaker, using mechanical connection between an ordinary earpiece and a gramophone reproducer. This idea proved so novel and efficient that we hope to pass on full detailed account through the medium of this journal for the benefit of all amateurs at an early date.

In conclusion the speaker was bombarded with many questions relating to telephones and loud-speakers' generally, all of which he dealt with in a very able manner to the satisfaction and enlightenment of everyone present.

Several new members were accepted and the meeting closed with a hearty vote of thanks to the lecturer and the Chairman at 10.15 p.m.

The Hon. Secretary, Mr. L. E. Lubbock, King George's Hall, East India Dock Road, Poplar, invites inquiries from all interested amateurs in the East London district.

### The Southend and District Wireless Club.*

Hon. Secretary, Mr. D. L. Plaistowe, 21, Oakleigh Park Drive, Leigh-on-Sea.

On August Bank Holiday last, a very interesting and successful event took place at the Rectory Grounds, in Leigh-on-Sea.

The exhibition and demonstration of reception on Club Members' apparatus, was well attended by the public, and messages and concerts, etc., were intercepted from 2 LO, 2 LZ, and many other local stations, in spite of the atmospheric conditions which were absolutely abnormal here.

To obtain results on the short aerial in use at the time it was necessary to add capacity in large amounts in series with A.T.I. and this cut down the efficiency of the circuit so much that signals on the Brown loud speaker were not loud enough to be heard all over the tent, so that the five-valve circuit with 2 H.F. will be used on a future occasion, so as to have some reserve of power to cope with changed conditions.

Messrs. Bridge & Son, showed a very compact and efficient three-valve receiver of the unit system, and their exhibition of component parts was of interest to many that evidently were just commencing reception of W.T.

A single valve portable receiver by the Leigh Wireless Stores was much admired, and in fact all club members that were in connection with the trade had made a good show in spite of short notice. It is hoped in October next to give a large exhibition, and to admit the public to a radio concert on proper lines which, being held in a building, should be successful, as it is difficult to carry the sound far in the open air or in a tent.

*Members of the Sheffield and District Wireless Society photograph in the Blue John Mine, Castleton, to which a visit was paid recently for the purpose of conducting underground experiments.*

A general meeting was held on August 18th, at Club Headquarters, St. John's Ambulance Depot, in Queen's Road, Southend.

Mr. Davies took the chair in place of Mr. Mayer who was unable to attend owing to business. The meeting opened at 8.10 p.m., and the Chairman called on the Hon. Secretary to read the minutes of the previous meeting. After the approval of the same, and following business arising therefrom, he called on Mr. Plaistowe to give his lecture on "The Fleming Valve and the Electron Theory in General."

The method of taking the characteristic curve was given, and the usual description of the popular theory of electronic action explained.

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After a hearty vote of thanks Mr. Jackson was called upon to talk on "Direction Finding." He explained very concisely the method of procedure and gave a typical instance and working by trigonometry. A general discussion then took place on the subject of the lecture, and Mr. Jackson was plied with questions which he very ably dealt with.

The meeting was declared closed at 10 p.m.

In common with most wireless societies at the present time we are being inundated with queries and demands for particulars of membership from people who are just commencing the reception of signals, etc., on apparatus purchased from some firm or other. We shall be very pleased to have them in the Society as members when we commence our winter session on October 6th.

In the past the Club of course consisted of "pre-boom" experimenters who all more or less had at least a knowledge of the fundamentals of electricity, so that it was no difficult matter for them to understand wireless theory and practice.

The people to-day, however, do not appear to have at all an extensive knowledge of electricity but yet are keen enough to purchase a "set" and commence operations, usually to the accompaniment of whistles, moans and shrieks, and other phenomena. In this town, particularly, there is too much of this sort of thing going on at the present time, and we want to help these people, and in doing so help ourselves.

Accordingly, we invite all amateurs in Southend and district to come along on October 6th to the Club-room and give their views in writing to the Hon. Secretary, so that the future policy of the Club can be adapted to suit the needs of the times.

### Ramsgate, Broadstairs and District Wireless Society.

Joint Hon. Secretaries, Mr. F. Harrison, Rochester Cottage, High Street, St. Lawrence, Ramsgate, and Mr. F. C. Marshall, 6, Ramsgate Road, Broadstairs.

The following gentlemen have kindly consented to become Vice-Presidents:—Hon. E. C. Harmsworth, M.P. (Thanet), Lieut.-Col. Sir T. B. Robinson, K.C.M.G., K.B.E., Sir Cecil Hertslet, K.B.E., J.P., Sir Edward Rigg, C.B., C.V.O., I.S.O., H. Bing, Esq., J.P., Rev. F. G. Ridgeway, M.A., James Emery, Esq., H. C. Flowerdew, Esq., W. G. Riddle, Esq., C. F. Grossmith, Esq.

Following an informal meeting held in July, a committee meeting was held on August 24th, at Ramsgate, under the chairmanship of the President, Mr. H. C. Norman, B.A., for the purpose of drawing up the rules and discussing the necessary details for the formation of the Society. The Committee of Management, composed of Messrs. H. C. Norman, B.A., E. Guy, M.Sc., E. P. Pester, B.Sc., C. E. Hume, P. F. Weeks, M.B.E., P. E. Stanley (Ramsgate), P. F. Cotton and F. C. Marshall (Broadstairs and District), considered the necessary rules and details for the formation, which were finally agreed and adopted. It was decided to divide membership into three sections: "Members," "Associates," and "Student Associates." Subscriptions to be 10s., 5s. and 2s. 6d. per annum. "Members" having two votes and the privilege of bringing a friend to meetings, etc., once a month. "Associates" having one vote but not the latter privilege. "Student Associates," being junior members still attending school. A full programme of weekly meetings is being arranged, of which either of the Hon. Secretaries will be very pleased to give full information. The list of members is increasing rapidly and much encouragement is being received locally. The first meeting will be held during September, at the close of the holiday season.

### Bishop's Stortford and District Amateur Wireless Association.

Hon. Secretary, Mr. J. Cooper, Halfacres, Bishop's Stortford.

Owing to increasing attendances the monthly meeting of the above was held at the Institute, Bishop's Stortford, on Friday, August 25th. There was a good attendance of members and visitors, presided over by Mr. W. A. Field, and a lecture was delivered by Mr. L. G. Attree, upon "Accumulators." The lecture which was full of technical information was delivered in a manner readily understood by the tyro, and dealt with the types, voltage, capacity, etc., best suited to radio work. Mr. Attree, whose experience of his subject is an exceedingly wide and long one, insisted upon the superiority of glass containers over those of celluloid or even of ebonite, and emphasised the need of care and maintenance in order to obtain maximum results. A vote of thanks, proposed by the Vice-President and seconded by Mr. Filby, was accorded Mr. Attree for his instructive lecture.

Communications should be addressed to the Hon. Secretary.

### Coventry and District Wireless Association.

Hon. Secretary, Mr. J. E. Bolus, Iona, 14, Coundon Road, Coventry.

A meeting of the above Society was held at the Club Room, Charlesworth Buildings, 128, Much Park Street, Coventry, on August 23rd, 1922, for the purpose of enrolling members into the Society which was reconstructed at the last meeting.

The Chairman, Mr. A. M. Sidley, addressed the meeting and pointed out the absolute necessity for a Radio Club in Coventry, and said that judging from the attendance there that evening amateur wireless appeared to be very popular in Coventry.

The Committee had been into the matter of entrance fees and annual subscriptions, and have fixed them at 5s. and 10s. respectively for senior members, and 2s. 6d. and 5s. for juniors.

There were 42 members enrolled, and it is hoped that this number will in the near future be considerably increased.

The club room is open to all members on any night, and arrangements are being made for a work bench and also a library of periodicals and technical books to be installed as soon as possible.

The Secretary will be pleased to give any further information on request; notices of lectures, etc., are published in the local newspaper, and are also shown in the various electrical contractors shops throughout the town.

### Newark and District Wireless Society.

Hon. Secretary, Mr. Geo. T. Sindall, 6, Beech Avenue, Hawtonville, Newark, Notts.

The above Society will resume their meetings for the winter session on Wednesday, September 20th, at the Magnus Grammar School, at 7.30 p.m.



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The Committee are hoping to make this session a greater success than the last, and hope all interested will make an effort to come along and join them, whether they are in possession of receiving sets or not.

A transmitting licence has been applied for, and in the event of this being granted much interesting work can be looked for which will be of great benefit to local amateurs.

**Hornsey and District Wireless Society.**

Hon. Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

This Society, which was recently founded, has now a membership of over 30, and is anxious to increase its numbers still further. Full particulars can be obtained from the Hon. Secretary at the above address on receipt of a stamped addressed envelope.

A full meeting was held on Friday, August 18th, and a programme was formed for future meetings.

It was arranged that the Club set should consist of three valves—one high frequency, one detector, and one low frequency. Mr. Pugh consented to make the panel, while Mr. Webster volunteered to make the cabinet to hold it. The whole of the Club members meet every Friday to construct various items to include in the set, which it is hoped will be in use by September 11th.

On Tuesday, August 22nd, the members present enjoyed music and speech from **2 OM** and **2 FQ** as well as Morse signals from various stations, including loud signals from **GFA**, and a two-valve set loaned by Mr. Webster for the evening. Other members have kindly consented from time to time to lend their sets for demonstration purposes.

**The Walthamstow Amateur Radio Club.**

Hon. Secretary, Mr. R. Cook, 49, Ulverstone Road, Walthamstow, E.17.

The Society is now well established and the membership is still steadily increasing, and an Assistant Hon. Secretary was appointed a short time ago in order to cope with the increasing business of the Club. On August 23rd, Mr. Tyler gave a lecture to the advanced members of the Club on "Ionization of Valves," and Mr. Webb lectured to the more elementary members on the approximate cost of constructing a valve panel and the necessary apparatus used.

The Committee are hard at work arranging the lectures for the Winter sessions.

The Secretary will be pleased to welcome any prospective member. Meeting nights, every Wednesday, from 7.30 p.m. to 10, at the Y.M.C.A. Church Hill, Walthamstow, E.17.

**The Durham City and District Wireless Club.**

On Friday evening, August 25th, the fifth meeting of the above was held. It proved to be a very enjoyable and intensely interesting evening for the members.

The Morse buzzer class, conducted by Mr. G. Nurthen, assisted by Mr. W. Rushworth, was quite exciting, the ladies particularly enjoying themselves.

After Morse practice the Hon. Secretary, Mr. Geo. Barnard, gave a short lecture on "Diagram Interpretation," using 22 diagrams upon the blackboard to represent various apparatus. These diagrams were copied by the members.

After the announcements, the Chairman, Mr. S. Kelly (Hon. Treasurer), commenced the question period by asking the Secretary to review briefly the last lecture on the relationship between inductance and wavelength of a closed oscillatory circuit. At the request of a lady member Mr. Barnard gave a condensed explanation of the function of a crystal detector in a receiving circuit. Mr. R. W. Holmes at this point drew and explained the curve representing the relationship of the resistance offered by a crystal to the E.M.F. applied.

A lively discussion then followed. Several new members were enrolled. There was no time to discuss the merits of a free library.

Mr. Ainsley, of the Henley Cable Co., is the lecturer for the next meeting, which is to be held on Friday, September 1st, at headquarters (Y.M.C.A., Claypath).

Intending members are always welcome.

**The Wireless Society of Liverpool.**

Hon. Secretary, Mr. C. L. Lyons, 76, Old Hall Street, Liverpool.

A highly successful meeting of the above Society was held on Thursday, August 24th, at the Royal Institution, Colquitt Street, Liverpool.

Special arrangements had been made with The Ashley Wireless Telegraph Co., Ltd., of Renshaw Street, Liverpool, whereby they would transmit telephony and musical items from their experimental station, **2 KH**, the same being received on a five-valve receiving set of their own manufacture (2 H.F., 1 Rect., 2 L.F. valves).

The programme commenced promptly at 8 p.m., and continued until 9.30, there being six-minute transmissions with intervals of five minutes duration each. The receiving set was operated by Mr. C. G. Williams, of Messrs. Ashleys (who is also a prominent member of the Society and on the Advisory Committee). The whole of the items were received extremely satisfactorily (especially in consideration of the fact that the set was worked in conjunction with the Society's indoor aerial which is of but moderate dimensions) and were made clearly audible to all present through a "Brown" loud speaker. The programme was very varied, containing amongst other items, selections from Gilbert and Sullivan, "Annie Laurie," "The Policeman's Holiday," a "Pot-Pourri" and then inimitable Tom Foy in a speaking record.

The five-minute intervals were occupied in answering the questions deposited previously in the question box, Mr. S. Lowey rendering great assistance, illustrated with very clear blackboard diagrams.

The next General Meeting of the Society will be held at 7.30 p.m. on Thursday, September 14th, at the same address, and all amateurs or interested persons of either sex are extended a hearty invitation.

A meeting of the General and Advisory Committee has also been arranged for September 7th, for the purpose of arranging an interesting and instructive winter syllabus. All intending members are therefore advised to apply at once to the Secretary for application forms, so that none of the special meetings which are being arranged, will be missed.

**Proposed Wireless Society for Tottenham and District.**

Will all interested please communicate with Mr. R. A. Barker, 22, Broadwater Road, Bruce Grove, Tottenham, N.17.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—*(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents.* (6) *Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of* 1*s.*, *or* 3*s.* 6*d. for a maximum of four questions.* (7) *Four questions is the maximum which may be sent in at one time.*

*In view of the serious interference which an oscillating receive can cause to other receivers in its neighbourhood, it is understood that for broadcast wavelengths, certainly, and possibly for all wavelengths, the Postmaster-General will in future allow no type of circuit which is capable of oscillating and so energising the aerial, either directly or through any circuit coupled to it.*

*The necessary consequence of this restriction is that if reaction of the type commonly used in the past is still employed, it must be in such a way that the oscillation point cannot be reached over the wavelength range of the receiver, however tightly the reaction coil is coupled, and with whatever values of filament voltage or plate voltage the set is worked.*

*In order to comply with this requirement, it is essential that the reaction coil should be sufficiently loosely coupled to the aerial inductances as not to set set up oscillations or alternatively the reaction might be arranged between the grid and plate circuits of a high frequency amplifier as shown on p.* 715 *of the issue of September 2nd.*

*We strongly urge readers who are making or using sets of the usual reacting type to either reduce the amount of reaction which they can employ to such an extent that they are perfectly satisfied that the set can never oscillate or to cut out their reaction entirely.*

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**"R.M." (Coventry)** *wishes to obtain a temporary post as operator next summer, and asks* (1) *If he could acquire sufficient theoretical and practical knowledge by self-preparation.* (2) *What books are recommended for studying purposes.*

(1) Theoretical knowledge, yes; practical efficiency, very unlikely. Moreover, we think it unlikely that you would get a berth under these conditions, as the supply of thoroughly qualified operators appears to be at least equal to the demand. (2) We should recommend Bangay's "Elementary Principles" and his "Oscillation Valves" for a start, and more advanced books and the P.M.G. handbook later.

**"L.S." (Stretford)** *has a set of which he encloses a diagram, which gives no results, and asks for assistance.*

The set appears fairly good although results are poor. Condenser D should go from the other side of reaction coil to earth, and should be about 0·001 mfds. The reaction coil should couple with secondary instead of the primary, and should be small enough to slide right inside it. Examine all aerial and earth connections and insulation very carefully.

**"W.V." (Fulham)** *asks* (1) *For an efficient two-valve receiving circuit which can be constructed at reasonable cost, and covering a wavelength range of* 180/200 *metres, with values of capacities, resistances, etc., and* (2) *Whether this will work satisfactorily in a horizontal position.*

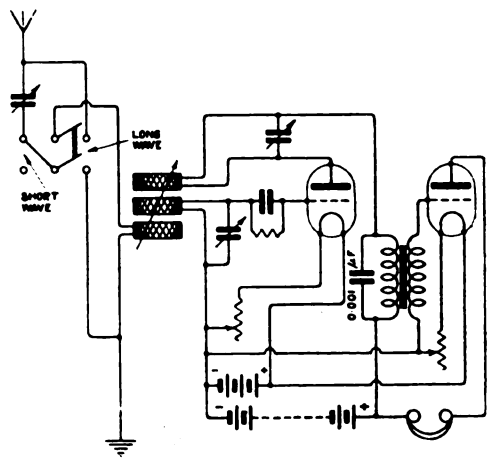


*Fig.* 1.

(1) See Fig. 1. (2) Receiving valves are usually so constructed that they can be operated in any position. This does not apply to large transmitting valves and rectifying valves however.

**"W.G.A." (Southampton)** *asks two questions relating to winding coils for his set.*

(1) The A.T.I. internal diameter 1", external 7". For the reaction coil 4" internal, 5" external diameter, wound with the same wire. (2) It is impossible to give at all accurate values. In this case we should recommend tappings at equal numbers of turns from the inside to the outside.

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"C.E.P." (Battersea) *asks* (1) *Will four solo receivers of 750 ohms each, connected in series, be efficient for telephony.* (2) *What current does a zincite-bornite combination need.* (3) *What additions does he need to a list of apparatus to make a crystal detector and valve amplifier.* (4) *For a diagram of a circuit for use with the above.*

(1) Yes, if of good make. (2) No polarising E.M.F. is necessary with this combination. (3) For the simplest type of circuit two batteries, L.F. and H.F., grid condenser and leak and L.F. inter-valve transformer. (4) See Fig. 2, page 336, June 10th issue, omitting the potentiometer and battery.

"J.W.A." (Northallerton) *is contemplating the construction of a three-valve receiver, and asks* (1) *The best simple circuit for making use of three valves for reception of spark, C.W. and telephony, up to wavelengths of* 3,000 *metres.* (2) *Whether the apparatus will be suitable to operate a loud speaker.* (3) *Whether resistance capacity or transformer coupling is recommended, and* (4) *The capacities of the various condensers.*

(1) See circuit, Fig. 2. For reception on wavelength up to 450 metres you had better make a special set of coils. (2) No; the addition of one or two stages of low frequency amplification is required. (3) As you do not require to receive on wavelengths above 3,000 metres, transformer coupling will be found satisfactory. (4) These are indicated in the diagram.

"R.C.W." (Clapham) *asks for details for adding one amplifying valve to the school set in the October 29th issue.*

The simplest way of doing this would be by adding an additional valve as L.F. amplifier, for which you would only require an inter-valve transformer and the extra valve and socket. The transformer might be 1 oz. and 3 ozs. of No. 44 on a core $\frac{1}{2}'' \times 4''$ of iron wires. The circuit may then be as in Fig. 3, p. 738, September 2nd issue.

"J.D." (S.E.18) *asks how to adjust Brown's "A" type telephones.*

To carry out the adjustment, screw up until a click is heard and signals become inaudible, then screw back until the point is reached where signals reappear.

"P.K." (Paris) *asks* (1) *If he should hear English stations with a two-valve set.* (2) *What English stations will he be able to hear.* (3) *If any English station sends telephony like* FL.

(1) and (2) You should hear some of the larger stations, such as Leafield, Carnarvon, etc., but probably not any telephony. (3) There is no corresponding station at present.

"———" (Bayswater) *encloses a sketch of circuit and asks* (1) *If A is a grid leak, and if so what should be its value for Mullard "Ora" valves.* (2) *If one variable condenser is sufficient.* (3) *What is to be connected at points D and C on the sketch.* (4) *Which of three coils should he use for reactance, and which for primary and secondary.*

(1) A is a grid leak. Its value should be about 2 megohms. (2) One variable condenser is sufficient for a simple single circuit set. It should be used in series with the A.T.I. for short waves, and in parallel for long waves. 0·001 mfds. is O.K. (3) Connect at B a 40-volt H.T. battery, positive

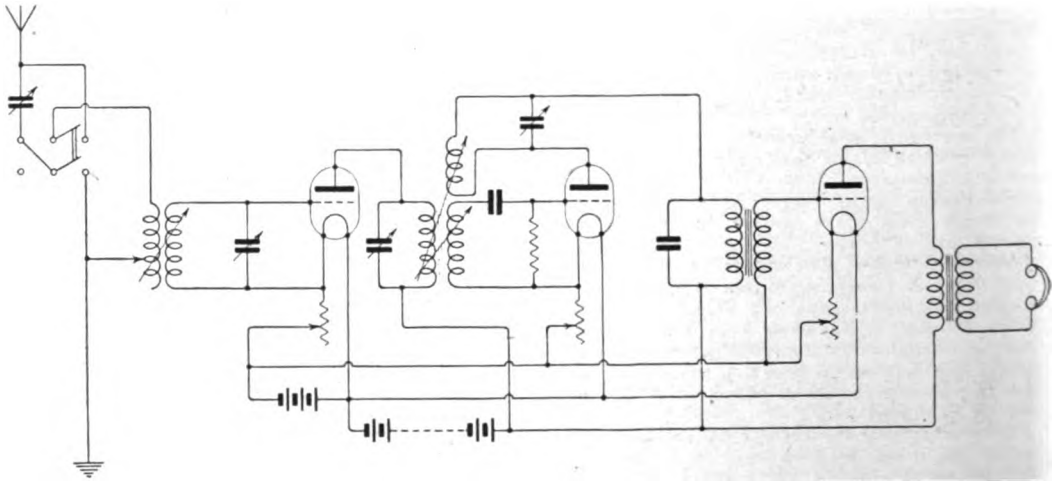

*Fig. 2.*

to the anode of the valve. At C connect a pair of H.R. telephones. (4) If the stated coil is used in the closed circuit the next larger may be used for the primary and the next smaller for the reaction.

"K.P.S." (Marlborough) *refers to the simple C.W. and telephony transmitter described on page* 292, *June 3rd issue, and asks for winding details of the induction coil for use on a wavelength of* 400 *metres.*

A suitable value for the inductance would be 40/50 turns of No. 20 D.C.C. on a 3" diameter former. We cannot give the exact number of turns as this will depend on the capacity of the aerial which may lie anywhere between fairly wide limits.

"C.M." (Camberwell) *asks if the Marconi* 1½ *kW. ship set is still the same as that given in the* 1918 *edition of Hawkhead, and if not what are the most important alterations that have been made.*

The standard rotary converter, asynchronous spark set, is obsolete, although very large

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numbers are still in use. It has been superceded by quenched spark set, with a motor alternator as source of power, and also by a C.W. valve set.

"**R.S.M.**" **(Croydon)** *asks* (1) *Why do crystal detectors rectify.* (2) *If celluloid varnish is any good as an insulator.*

(1) If you wish to know *how* the actual process by which it works we are afraid we can give you little help, as the action is really not understood and various theories are in existence. We really understand as much about it as we know why such and such a crystal is black, or any other colour. On the other hand most elementary text-books give simple explanations of the process, which give some idea of the action. (2) We have not had extended experience with this material for the purpose, but such work as we have done would point to it being satisfactory.

"**NOTSEW**" **(London)** *sends a sketch of his set and asks* (1) *What would be the maximum distance from which amateur telephony, high power telephony and high power telegraphy would be received clearly.* (2) *Are any improvements possible in the set sketched.* (3) *On what wavelength Croydon now works.* (4) *What would be the difference in wavelength if a* 0·0005 *mfd. condenser is used instead of a* 0·001 *mfd.*

(1) Amateur telephony, perhaps 20 miles; Broadcasting telephony, 40 to 50 miles; telegraphy, almost any distance, depending on the power of the transmitting station. (2) A condenser (0·001 mfds.) across the telephones is very desirable. (3) Not very different from 900 metres.

"**PIP**" **(Manchester)** *refers to the American short wave receiver described in the issue of June 3rd, and asks* (1) *What is the value of the variable condensers in the diagram* (a) *in the grid circuit of the valve and* (b) *across the telephones, and if these should be variable.* (2) *If there is no grid leak in this circuit.* (3) *Would this receiver be suitable for receiving broadcasting.* (4) *What is the highest wavelength from which this set would receive telephony.*

(1) (a) 0·0003 mfds.; (b) 0·001 mfds. Neither need be variable, but the grid condenser may be with some advantage. (2) A leak should certainly be introduced between the grid side of the condenser and the filament. (3) Quite. (4) No definite limits. Should be O.K. up to say 1,200 metres.

"**LITTLE LEVIS**" **(Ilkeston)** *asks* (1) *For a list of apparatus for constructing a set capable of receiving telephony* 150 *miles.* (2) *Would a certain type of aerial be O.K.* (3) *Which of two aerial systems is preferable.* (4) *Which is the best receiving set on the market.*

(1) If you wish to receive **FL** or similar stations at this distance, your set may be quite simple, say three valves. If, however, you wish to receive broadcasting stations at this distance you will require at least three valves, with tuning coils, two variable condensers, H.F. and L.F. transformers, batteries, grid condenser and leak, telephones and variable filament resistance. (2) Yes. (3) 40 ft. high and 40 ft. long single wire. (4) We cannot answer this for obvious reasons, but the best sets, costing say £35 to £50, of most of our advertisers are all very good.

"**T.L.H.**" **(Cardiff)** *asks* (1) *For advice as as to how to stop his set oscillating.* (2) *If he can receive broadcasting without any alteration to wiring.* (3) *If it would be of any benefit to connect the H.T. battery in series with the L.T. instead of in parallel.*

(1) Try reversing the windings one at a time, also vary the positions of the transformers, or fit each transformer into a closed iron box; also make sure that your reaction coupling is not too tight. (2) Yes, provided that your H.F. transformers and tuning coils are O.K. (3) Your present arrangement is not a parallel connection, as only the negative ends are common. There is very little difference in action between the two ways shown.

"**R.St.Q.L.**" **(Harlech)** *asks* (1) *If a three-electrode thermionic valve can be used as an amplifier on an ordinary telephone circuit in conjunction with a loud speaker.* (2) *If so, would the ordinary wireless type do.* (3) *What circuit would be suitable and what accessories needed to amply the current from an ordinary telephone with induction coil.*

(1) and (2) Yes. (3) The circuit should be an ordinary L.F. amplifier, with a special input transformer with its primary adjusted to suit the conditions of the telephone line. *N.B.*—The making of any experimental modifications of this nature on the Post Office system is illegal without express permission from the P.M.G.

"**G.A.M.**" **(Kensington)** *sends a sketch of his set and asks* (1) *If the grid leak and condenser will act as reaction between the secondary and the valve.* (2) *If he could receive a wavelength of* 250/3,000 *metres with this set.* (3) *For criticism of circuit.*

(1) No, you will not get any reaction in this way. (2) If your coils are wound with about No. 26, you should get this range, but 0·001 mfds. is too high a value for the grid condenser. (3) The set would work as shown, but would be better with the variable condenser across the secondary, and with a slider to the primary. The addition of a reaction coil would also give greater sensitivity.

"**J.M.G.W.**" **(Godalming)** *sends sketch of his set and asks* (1) *If the circuit is correct.* (2) *If one lattice coil will do for a reactance for the set. If so, what should be its inductance in mhys.* (3) *What size series condenser should be used to tune to* 300 *metres.* (4) *If telephony from* **FL, 2 MT, GED, 2 LO,** *and* **GEG** *could be heard.*

(1) Quite O.K. (2) Yes, about 1,000 mhys. should be sufficient. (3) About 0·0002 mfds. should be satisfactory. (4) **FL** probably, **2 MT** possibly, **GED** and **GEG** doubtful, **2 LO** yes.

"**RED SUEZ**" **(s.s. "Mansourah")** *sends sketch of circuit and asks* (1) *If it will operate with reaction.* (2) *If it would operate with heterodyne.* (3) *If it would be difficult to operate.* (4) *If it would operate off common batteries.*

(1) Yes. We think the scheme suggested should be quite satisfactory. (2) Certainly. (3) The circuit might need very careful adjustment for successful results, but we have no actual experience of its behaviour. (4) We can see no reason why it should not.

"**J.G.B.**" **(Brighton)** *sends diagram of set and asks* (1) *If values for H.T. and L.T. are correct.* (2) *If he should hear* **2 MT** *and* **PCGG.** (3) *If tramways, which run about twenty yards from the house, will affect reception.*

(1) Circuit is quite O.K., but you should interchange the 0·003 mfd. grid condenser and the 0·0005 mfd. anode bye-pass condenser. (2) Reception of **PCGG** and **2 MT** on a single valve set

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at Brighton are both very unlikely. (3) You may have considerable trouble through induction from trams.

**"CENTIGRADE" (Bury)** *asks* (1) *If a valve amplifier may be used with crystal set.* (2) *If he would be able to receive telephony from* FL *with a crystal set made as shown in the "Amateur Mechanic."* (3) *If zincite-bornite is the best crystal to use.*

(1) Yes. (2) Unlikely at such a distance, but not impossible with a really good aerial. (3) Zincite-bornite is one of the most sensitive combinations. (4) Ordinary valve 4 volts, 0·5 to 1 amp. Low temperature valve, 2 volts, 0·1 to 0·4 amps.

**"F.P.O." (Liverpool)** *asks for a diagram arranged with switches for effecting (a) A.T.C. series parallel; (b) L.T. and H.T. on and off; (c) Crystal reception only, valve H.F. magnifier followed by crystal rectifier.* For circuit see Fig. 3.

Separating them would then gradually reduce the wavelength to about 850 metres. (3) There is no suitable formula in existence. (4) No, it will not tune up to the wavelength.

**"J.O.B." (Westcliff-on-Sea)** *asks* (1) *What is the advantage, if any, in using a crystal detector with a local potential, such as zincite-bornite, over one without any potential.* (2) *Why he gets no results with a certain circuit sketched.* (3) *If better results can be obtained by using a crystal detector and valve amplifier.* (4) *How tuning is performed without a sliding contact.*

(1) Zincite-bornite does not require a local potential. In general the crystals which require applied local potential are more steady but somewhat less sensitive than those which do not need it. (2) The circuit appears O.K. and we can suggest no reason from the diagram for it not working, except

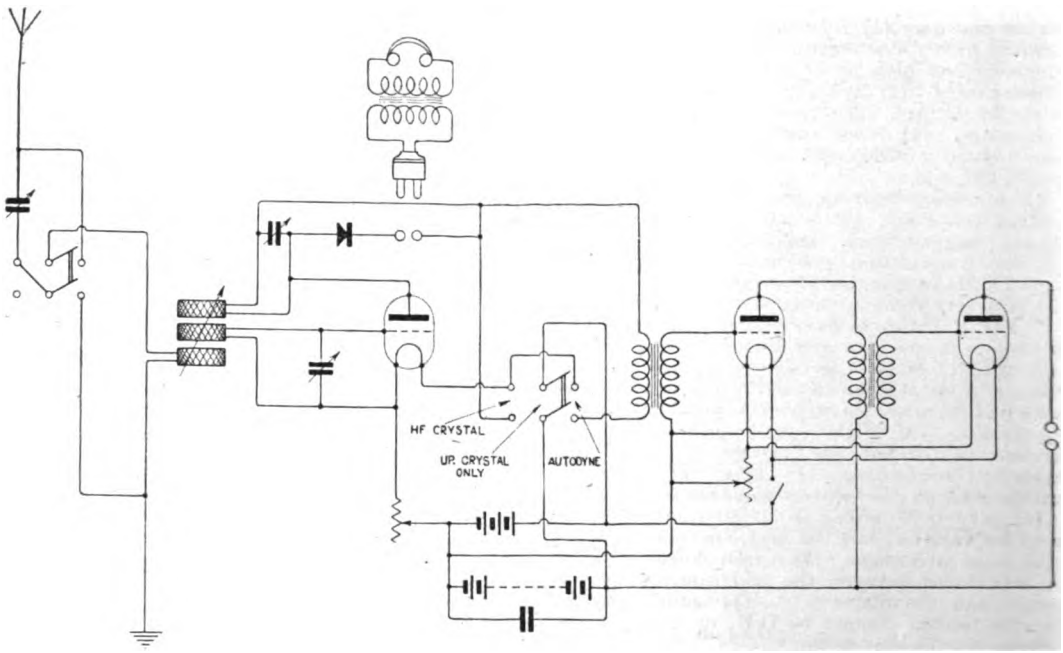


*Fig.* 3.

**"2 BAH" (Dartford)** *asks* (1) *For a formula for calculating the wavelength of a single layer coil for use in a wavemeter.* (2) *If two pancake coils placed parallel and concentric are connected in series so that the induction is maximum, what is the effect of separating the coils.* (3) *For a formula for calculating a self capacity of single layer and pancake coils.* (4) *If it would be possible to hear* FL *with the crystal circuit sketched.*

(1) It is impossible to calculate the wavelength of a coil used in this way, as the wavelength depends on the self capacity of a coil, which cannot be calculated. A true inductance coil having no self capacity would have no wavelength. (2) As above, a good coil has no wavelength. If, however, the coils would each tune the circuit to 600 metres, placing the two together in the circuit would give a wavelength of approximately 1,200 metres. that 4 volts is rather a low value for the filament battery for this valve. (3) See Fig. 3, page 501, July 15th issue, for a suitable circuit. (4) Tuning can be carried out by a variable shunt condenser, or by a variometer action between two coils connected in series.

**"L.S.G.H." (Fulham)** *asks for a diagram of connections for a five-valve set.*

Circuit should be as in Fig. 5, page 62, April 8th issue, with additional H.F. and L.F. valves switched in exactly the same way as shown, if desired.

**"W.S.F." (Darlaston)** *asks* (1) *If a sample of wire will be suitable for a telephone transformer for Sullivan's telephones used in a valve set; also if a certain sample of tinplate will do for a core.* (2) *What size former should be used to wind certain specimens of wire upon, and how many turns of each should be used.*

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(1) The sample of tin might be used, but will be inefficient, especially for telephony in comparison with stalloy iron. If used, it will be better to put tissue paper between sheets. (2) The wire is too thick, even for L.R. winding, but if used try about 2,500 turns.

**"J.E.W." (Great Berkhampsted)** *sends a sketch of his single valve set, and asks* (1) *Why he gets no results.* (2) *What should be the maximum and minimum wavelength.* (3) *What is the approximate capacity of the variable condenser.*

(1) We can see no reason why the set should not work. It would, however, be improved by the addition of some reaction. (2) We cannot say, as you do not give the dimensions of the A.T.I. former, but from the length of wire used the maximum is probably several thousand metres. (3) 0·00035 mfds.

**"C.S.H." (Harlesden)** *sends a sketch of his set and asks* (1) *What is its wavelength range.* (2) *Capacity of two certain condensers.* (3) *If a certain coil is suitable for use with a two-valve resistance capacity coupled set, and also with the set in his diagram.*

(1) Approximately 6,000 metres. (2) Condenser No. 1, 0·0007 mfds., No. 2, 0·00015 mfds. (3) Yes, but in your sketched circuit it is better to put the reaction coil on the anode side of the inter-valve transformer.

**"H.H.T." (South Kensington)** *asks* (1) *For a diagram of connections for a four-valve receiving set, with loud speaker, range from 150 to 25,000 metres.* (2) *What valves are recommended for this set.* (3) *Winding data for transformers.* (4) *If the inductances and condensers could be made as shown in "A long range Receiving Set," of Vol. 8.*

(1) See Fig. 7, page 438, issue for July 1st. (2) Any good modern type will do. Cylindrical tube valves of "V.24" type are electrically somewhat more efficient than French type, but for certain purpose are, perhaps, not mechanically so good. (3) In order to cover such a large range you will have to have a number of H.F. transformers, the windings of which must be determined experimentally. For the L.F. transformers, the values usually quoted may be used. (4) They might be, but we do not particularly like this arrangement. We should recommend a three-coil holder with a set of honeycomb coils.

**"L.J.B." (Sheffield)** *sends diagram of a crystal set he is using with an indoor aerial and asks why he cannot get signals.* (2) *What crystal to use.* (3) *If 60 ohm telephones can be used.* (4) *If using German silver wire for his potentiometer explains lack of signals.*

(1) and (4) Circuit is quite correct and use of an indoor aerial is the only apparent reason for loss of signals. (2) Carborundum is perfectly satisfactory (3) Yes, if a telephone transformer is used, but your circuit does not show one.

**"F.J.A." (Mile End)** *asks* (1) *How he could construct a set of basket coils and what number of pins and turns to use.* (2) *How can he make reaction coils for these.* (3) *How many fixed and moving vanes are necessary to construct a 0·001 mfd. variable condenser.* (4) *In what text-book can he find similar practical information.*

(1) Any reasonable odd number of pins may be used, say between 9 and 19. The number of turns will depend on the wave-range required, which you do not state. (2) Reaction coils may be made in the same way as tuning coils. (3) It depends on the size and spacing of the plates. If the plates are 4" diameter spaced 1 mm. apart, 17 fixed and 16 moving will be required. (4) See Alan Douglas' Text-book on the "Construction of Valve Sets."

**"OZONE" (Kensington)** *asks* (1) *From what places in the British Isles and Europe are concerts and other information sent out for reception, and on what wavelengths.* (2) *For details of a complete valve circuit for receiving telephony.*

(1) The most important are Writtle **(2 MT)** on 400 metres, Marconi House, London **(2 LO)** on 360 metres. (This is experimental at present.) Eiffel Tower on 2,600 metres. Nauen on 3,100 metres **(POZ).** The Hague **(PCGG),** 1,050 metres, and a number of small power stations in the London District. (2) The four-valve set, of which descriptive articles started in the issue of July 15th, should be very suitable for this work.

**"E.D.B." (South Croydon)** *asks for a switching arrangement to cut out the last valve in the diagram on page 37, April 8th issue when required.*

Arrangement may be as in the diagram in which only the altered parts are shown (Fig. 4).

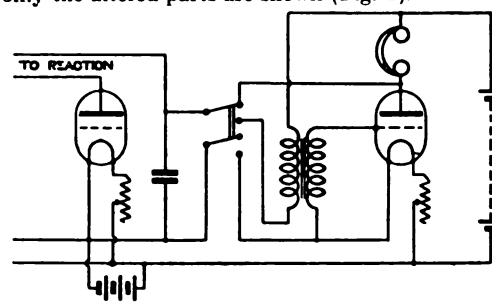


*Fig.* 4.

**"J.H.K." (Mortimer)** *asks* (1) *For a diagram of a good one-valve circuit.* (2) *If an "Ora" valve will give good results in this circuit, and should it be hard, medium, or soft.* (3) *What length of wire and what resistance, using No. 26 S.W.G., would be suitable for a filament resistance.* (4) *If a German "A.E.G." valve would give as good results as the Mullard "Ora."*

(1) See Fig. 2, page 537, issue for July 22nd. (2) Yes; hard. (3) About a couple of feet will be necessary, resistance of which would be 5 ohms. (4) We cannot say.

**"DART" (Devon)** *asks* (1) *If a certain method of constructing an aerial would give any results.* (2) *If so, how many valves would be required.* (3) *What is the approximate range of the 10-watt transmitting power usually granted by the P.M.G.*

(1) It is very unlikely that results of any use will be obtained. (2) At least five valves would probably be necessary. You have a difficult problem to solve. (3) The range varies enormously with locality and conditions. 10 to 20 miles might be an average figure, but much greater distances could be obtained under specially favourable circumstances.

**"L.D." (West Ewell)** *asks why he cannot get any telephony with his set.*

You give practically no useful information to enable us to say what is wrong, *e.g.*, you do not

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state the diameter of coils, material of formers or type of circuit. We see no reason why there should be anything wrong with the coils, but from your remark on howling we should imagine that you are using one as reaction, and that the coupling is too tight.

**"W.J.T." (Norbiton)** *asks* (1) *What is the wavelength, call sign and time of working of the station at Cairo working with Leafield.* (2) *Who is the arc station on about* 6,800 *metres, louder than Leafield.* (3) *If* **2 MT** *has reduced his power since operating on* 400 *metres.* (4) *Particulars of how to make a loud speaker using a Skinderviken microphone button.*

(1) **SUC.** We are unacquainted with programme of working. (2) Probably Northolt. (3) No; but is quite likely that the shorter wavelength does not carry so well over London, although we have received no systematic reports to this effect. (4) This could probably be arranged on the lines of the sketch, but the loud speaker itself would be quite distinct from the microphone and of normal type, but with windings adjusted to suit the resistance of the microphone through a transformer if necessary. A diagram of a simple microphone relay will be given in an early issue.

**"P.E.P." (Warrington)** *asks* (1) *If a two-wire aerial instead of a single wire would compensate for lack of height at one end.* (2) *If a long earth wire would be detrimental to the working of a single valve receiver.*

(1) The addition of a second wire will not compensate for lack of height. (2) This length of earth wire will weaken signals considerably. Cannot you connect it to a waterpipe nearer the house?

**"A.R.O." (Chester)** *asks* (1) *Where he can obtain a valve of the low temperature type, and at what price.* (2) *If certain wires would be suitable for telephone transformer for* 120 *ohm telephones.* (3) *If so, how much would be required.* (4) *If a certain diagram is correct for deriving H.T. for an "R" valve from a* 210 *volt D.C. main.*

(1) This valve will be handled by the Marconiphone Department of the Marconi Company. No supplies are yet available for distribution to the public. The price will probably be £2. (2) They might be used for the L.R. windings, but are undesirable even for this. (3) About 6 ozs. for the L.R. winding. The H.R. winding should be 3 ozs. of No. 44. (4) No; better to put three lamps in series and tap the required H.T. across one of them.

**"M.R.C." (Alexandria)** *asks* (1) *If we know of any wireless amateur in Egypt or Alexandria.* (2) *If any telephony can be heard in Alexandria with a seven-valve amplifier.* (3) *If the Wireless Society of London accept affiliation of foreign members living abroad.* (4) *Where can he find information for constructing a tuner with range* 600/25,000 *metres to be used with an amplifier and a seperate heterodyne.*

(1) We do not know of an experimenter to whom we could refer you. Why not advertise in a local newspaper? (2) We do not think this is at all likely, but we believe the question of establishing broadcasting stations in that part of the world is under consideration. (3) We think it is most probable that the Society would consider this. Apply to the Secretary for full information. (4) If you already have a suitable amplifier the construction of a tuner should afford you little difficulty. Make or buy a three-coil holder and use a set of honeycomb coils, tuning both the aerial and secondary circuits with variable condensers.

**"R.J.K.H." (Walton-on-Thames)** *asks* (1) *Why, on pressing the key of a simple valve transmitter, the valve filament decreases in brilliancy slightly.* (2) *What qualifications are necessary to become a member of the Wireless Society of London.*

(1) Without a knowledge of the circuit employed it is not possible to say exactly, but one possible cause is a decrease of potential along the filament of the valve due to an increase in the plate filament current. The plate filament current runs out through filament back through the circuit to the plate, and if in opposition to the filament heating current may give the effect noticed. (2) You should apply for full particulars to the Secretary of the Society.

**"ERIN" (Upton Manor)** *asks* (1) *How he can remedy howling.* (2) *If it would be possible to receive The Hague and Eiffel Tower telephony with a Mark III Tuner loaded with a proper coil.* (3) *Which of two samples of wire would be better for lengthening the aerial.* (4) *If it would improve signals to use insulated wire as per sample attached.*

(1) Howling is evidently due to too much reaction; do not use so much. (May we remind you that whenever your set howls in this way, you are spoiling the reception of every other amateur within a range of perhaps two miles). (2) The wavelength of the closed circuit should also be brought up to the desired values. (3) Either should be quite satisfactory. (4) No. The 7/22 would be slightly the better of the two.

**"A.F.W.A." (North Woolwich)** *asks* (1) *The number of turns for four coils.* (2) *To what wavelength will a coil* $10'' \times 1\frac{3}{4}''$ *tune with a certain aerial.* (3) *For winding data for a certain H.F. transformer.* (4) *If a variable condenser is necessary if there are four tappings in the H.F. transformer primary.*

(1) For 400/600 metres, 100 turns. For 500/1,000 metres, 150 turns. For 900/1,500 metres, 250 turns. 1,500/3,000 metres, 400 turns. These should be approximately correct, but the exact value should be determined by experiment. (2) About 1,200 metres. (3) It is very difficult to predict this at all accurately. Try about 200 turns for each winding, with taps at 30, 60 and 100, but considerable adjustment may be found necessary. (4) This would be desirable for the range suggested.

**"E.H.W." (Madeira)** *refers to the article on the American short wave receiver in the issue of June 3rd, and asks* (1) *If there would be any advantage in winding the coils with a coil winder.* (2) *If it would be better to use a telephone transformer instead of connecting the telephones in the H.T. circuit.* (3) *If a telephone transformer is used should the variable condenser be connected across the transformer primary or across the telephones.* (4) *What type of transformer would suit the instrument.*

(1) Not for short wavelengths. (2) It can be done, but there is no appreciable advantage. (3) Across the primary. (4) Any normal type of telephone transformer will do.

**"FLAX" (Pershore)** *asks* (1) *For details of telephone transformer for Brown's* 120 *ohm telephones.* (2) *If L.R. telephones with transformer*

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*are as suitable for one, two or three-valve sets as H.R. telephones.*

(1) Use a core 4" × ½" of soft iron wires. For the L.R. winding, 6 ozs. of No. 32, and the H.R. winding, 3 ozs. of No. 44. (2) L.R. telephones are quite suitable. They are slightly less sensitive but somewhat less liable to break down.

**"ACK EDWARD" (Ferndale)** *refers to the Armstrong super-regenerative circuit recently described, and asks* (1) *Winding data of the inductances L.1, L.2, L.3, L.4 and L.5.* (2) *For the capacities of the variable and fixed condensers in the secondary circuit Fig.* 1. (3) *The capacity of the variable condenser in the oscillator circuit.*

(1), (2) and (3) The values of inductance and capacity in L.1, L.2 and L.3 circuits, should be those normally used for short wave work. The L.4 and L.5 circuits should have constants suitable for about 30,000 metres. The best proportion should be determined by experiment with the particular valves used. We consider that it is unlikely that an amateur will be able to get a circuit like this to work satisfactorily unless he has sufficient experience to construct circuits from the above data. See page 648, August 19th issue.

**"N.H.E." (Fouroaks).**—It is preferable to put the rectified oscillations through an earlier valve for re-amplification. For one of the various possible circuits see Fig. 5. A 1/3 transformer as suggested will be suitable.

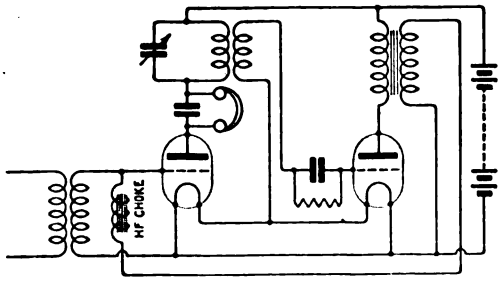


*Fig.* 5.

**"R.S.C." (Bath)** *asks for directions and a diagram for making a set with a range of* 500/800 *miles.*

We are afraid your requirements are too vague for us to help you much. For instance, the range depends on the transmitting stations power. You could get 800 miles on Eiffel Tower with a crystal, while there is no set in existence capable of the distance on short wave broadcasting telephony. For all round purposes you might adopt a three-valve set described by Harris in the issue of July 15th, and the following numbers. The aerial should be as high and as long as possible, subject to the P.M.G.'s restrictions of a maximum length of 100 ft.

**"R.A." (West Derby, Liverpool)** *refers to the Armstrong circuit, and asks* (1) *If the two inductances L.4 and L.5 must be of the same wavelength as the A.T.I. or does the condenser tune them to any wavelength.* (2) *Could the tapping at the top of the secondary be taken to the top of the A.T.I. instead.*

(1) The inductances of the L.4 and L.5 need not be the same as that of the A.T.I. For satisfactory work the circuits in which they are placed should oscillate on a wavelength considerably longer than that on which signals are being received, say 30,000 metres. For this purpose these coils should therefore be considerably larger than the A.T.I. (2) The tapping could be taken to the A.T.I. as you suggest, but results will not probably be so good. You will also probably get curious re-radiation results.

**"E.M." (Ipswich)** *asks where he can obtain single layer inductances for the set described on page* 471 *of July* 15*th issue.*

We do not know of any makers who are turning out coils exactly suitable for this set, as in general anyone using a set prefers to wind his own coils—a quite easy matter. You could, of course, obtain suitable formers from most dealers, or you might obtain the finished coils to order from such firms as advertise their willingness to make up articles to clients' specifications.

**"M.B." (N.19)** *asks for advice in the construction of his aerial.*

Your aerial might be run across the roof as suggested, but it will not be very efficient unless its supporting masts are fairly high, as the effective height will only be approximately the height of the wires above the roof, and not the height above the ground. See Article on Aerial Construction on page 259, May 27th issue.

**"D.G.N." (Harpenden)** *asks* (1) *If a circuit using reactance capacity for H.F. amplification is more efficient than a circuit using a plug in the H.F. transformers.* (2) *If a single layer coil or various proprietary types are most suitable for short wave reception.* (3) *For winding details of certain coils.* (4) *If there is any definite ratio between the primary and the secondary of honeycomb coils.*

(1) There is very little to choose between good examples of these two types. (2) For short waves we prefer single layer coils, the remaining types are all of approximately the same efficiency on short waves. (3) In order to tune to 11,000 metres, the A.T.I. should be 6" long, wound with No. 22; closed circuit, 5" of No. 24; reaction, 4" of No. 28. (4) No.

**"C.W.N." (East Croydon)** *asks* (1) *What is the wavelength range of a certain aerial loading coil.* (2) *The wavelength range of a certain loose coupled tuner.* (3) *What capacity air condenser is needed to tune "STI" coil to* 3,500 *metres.* (4) *If he would get better results on long wavelengths by using "STI" coils wound with No.* 26 *or No.* 28 *wire with more tuners.*

(1) The inductance should be 6,000 mhys. This will tune the P.M.G. aerial to about 2,250 metres. (2) The inductance should be 2,000 mhys. (3) 0·002 mfds. (4) Yes.

**"E.J.B." (Bath)** *asks* (1) *For a diagram of a four-valve set for receiving telephony and C.W. up to* 10,000 *metres.* (2) *The values of inductance capacity, etc., for this set.* (3) *What is the best type of valve to use.* (4) *If a* 220 *volt main, with suitable resistance, will answer as H.T. instead of usual dry cell battery.*

(1) See Fig. 7, page 438, July 1st issue. (2) The A.T.C. 0·001 mfds., secondary condenser 0·0005 mfds. For tuning we should recommend a set of honeycomb coils with the number of turns ranging from 30 to 750. (3) Any good class valve now on the market should be O.K. (4) D.C. mains



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can be used if desired, the method being as given in the issue for June 17th issue.

**"H.F.C." (Birmingham)** *encloses a diagram of his four-valve circuit and asks* (1) *For criticism.* (2) *For full details of constructions of the four transformers in sketch.* (3) *For the names of three of the most distant stations this set will receive.*

(1) The set is O.K., except that too much L.F. amplification is used. We should prefer the circuit of Fig. 7, page 438, issue for July 1st. (2) We regret we have not the required information available. (3) You should hear London and other British broadcasting stations at similar distances; also the higher power stations FL and probably PCGG.

**"T.M." (————————)** *asks* (1) *For winding data for a tuner, wavelength* 180/700 *metres.* (2) *If a certain arrangement of aerial will give increased range and louder signals on wavelengths over* 1,000 *metres.* (3) *Number of foils as per sample required for the condensers described; also a formula for calculating their capacity.* (4) *If a certain transformer would be any use as an intervalve or telephone transformer.*

(1) The A.T.I. 6″ × 4″ of No. 22, with four tappings, say about ½ lb. of wire. Closed circuit 5″ × 2½″ of No. 28 with four tappings. Reaction 4″ × 3″ of No. 22 with two tappings. (2) We cannot say as you do not describe the present aerial. Probably not much difference. (3) Your samples have not come to hand. For formula see reply to "Radio 3 UC," August 5th. The area of overlap means "the area (measured on one side only) of the part of each piece of mica which has foils on both sides of it." The formula will enable you to determine the capacities required. (4) Impossible to say from the few particulars supplied. If you could let us have sizes of wire and resistances of various windings we could advise you.

**"JUST COME UP" (Halifax)** *refers to the four-valve set described in the July* 15*th and* 22*nd issues, and asks* (1) *How to connect the two instruments together.* (2) *What coils to use from* 180 *ms. up to the Dutch concert.* (3) *The respective uses for stand-bi and tune.* (4) *If the primary coil is between the reactance and the secondary.*

(1) Connect the detector terminals of the tuner to the input terminals of the amplifier, and the reaction terminals on the two instruments together. (2) Use coils with about 40 turns on each for the shortest lengths, and about 120-150 turns for the Dutch concerts. (3) "Stand-bi" is used for finding the required station, as the receiver in this condition is much less selective than when on tune side. When the desired station is found it is generally best to switch over to tune, in order to get the extra selectivity. (4) The secondary should be between the primary and the reaction coil.

**"J.H.D." (Hollingbourne Manor)** *asks if the amplifier described by Mr. Campbell Swinton in the issue of June* 25*th is suitable for short wave telephony.*

The circuit suggested should be quite satisfactory for your purpose. The reason for the increased spacing required is probably that your coils themselves are bigger than the originals. Possibly poor results with PCGG are due to the inefficiency of the H.F. transformers at this wavelength, although the transmitting station is not very good at the time of writing.

**"E.H.L.S." (New Jersey)** *asks* (1) *For a diagram of a three-valve receiver with a range of* 150/15,000 *metres.* (2) *What kind of valves should he use with this receiver.* (3) *Where he can obtain French "R" valves.* (4) *What should be the voltage of the H.T. battery for this set.*

(1) See Fig. 1, page 435, July 1st issue, but omitting the reaction there shown. (2) Any standard hard valve on the market will be suitable. (3) We are afraid we are not sufficiently conversant with the sales position in the U.S.A. to advise you. You might consult the Radio Corporation of America, but you will probably find some difficulty in getting these valves in the U.S.A. (4) It depends on the voltage of the valve used, which will be stated by the makers or vendors. The values vary from 30 to 80 volts.

**"TYRO" (Chelsea)** *sends a diagram of his single valve set and asks* (1) *How to add a four-valve amplifier with H.R. telephones or loud speaker; also capacities of condensers, types of valves, etc.* (2) *If a second variable condenser in parallel with the secondary coil would improve results.*

(1) In view of the drastic alteration proposed it would be best to scrap the present panel and incorporate the components in a five-valve set on the lines of Fig. 1, page 570, issue for July 29th. Suitable values for the component parts have been repeatedly quoted. (2) The condenser, as suggested, would not greatly improve results, but a fixed condenser across the telephones would be desirable.

**"P.H." (Esher).**—Full information for the construction of a set of the type you require with four valves will be found in the issues for July 15th and 22nd.

**"RECTIFIER" (Tottenham)** *asks what battery voltages to employ with "Ora" valves.*

Forty volts should be sufficient for the plate, and 4 volts for the filament, but a 6-volt battery allows rather more latitude for filament lighting.

## SHARE MARKET REPORT.

Prices as we go to press on September 1st are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 5 | 0 |
| ,, Preference .. .. | 2 | 2 | 6 |
| ,, Inter. Marine .. .. | 1 | 9 | 0 |
| ,, Canadian .. .. | | 10 | 0 |

Radio Corporation of America:—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | 1 | 2 | 0 |
| Preference .. .. .. | | 14 | 0 |

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THE
WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
VOL. X. No. 25. SEPTEMBER 16TH, 1922. WEEKLY

# The Unit System as applied to a Wireless Receiving Installation

By W. FORBES BOYD.

THE great advantage of the unit system as applied to the design of Wireless apparatus is the flexibility that the system offers.

This system, where each section is designed separately, should present an attractive feature not only to the novice who prefers to build up a receiving set gradually, but also to the experienced worker who desires to increase amplification with additional valves or experiment with a particular section to improve signal strength.

As is well known, a wireless receiving set can be divided into two sections :—

(1) Tuner Section.
(2) Amplifier Section.

TUNER SECTION.

Originally it was arranged that the tuner section would be as described in *The Wireless World and Radio Review*, July 29th, 1922, but a more simple type of tuner has been designed and is described below for the benefit of those who wish to keep the size of the set to a minimum, or who require a tuner with the smallest number of complications.

The tuner section is therefore described as one unit, and has an open oscillatory and reaction circuit only. If a closed oscillatory or loose-coupled circuit is required in addition, it is a simple matter to embody this as a separate unit.

AMPLIFIER SECTION.

The amplifier section, consisting of the valves and their attendant accessories, can be arranged to include any number of valves, but for the purpose of explanation, and to give a variety of the uses of the valve, a four-valve amplifier is described below made up as follows :—

(1) High Frequency Amplifying Unit.
(2) Rectifying Unit.
(3) Low Frequency Amplifying Unit.
(4) Telephone Unit.
(5) Terminal Unit.

DETAILS OF TUNER SECTION.

Reverting back to the tuner section; in order that this section should be reasonably narrow in width, it was decided that the plug-in method of obtaining different wavelengths by means of aerial inductances and reaction coils should be adopted, and in order that reaction should be obtained at short wavelengths the single layer coil in the form of flat pancakes is introduced for coils up to 75 turns. Beyond this range the standard duo-lateral coil is used.

The advantage of a series condenser being established for reaction at short wavelengths, and in order that only one variable condenser be used in the aerial circuit, experiments were made to retain the variable series condenser, and at the same time embody a fixed condenser so as to increase the range of wavelength covered by the variable condenser.

It was found that a 0·001 mfd. variable condenser in the earth lead and a 0·001 mfd. *fixed* condenser between aerial and earth gave these results, and whilst this arrangement scarcely alters the minimum wavelength for a particular inductance it increases the maximum wavelength about 60 per cent. as compared with the series condenser only.

Different values of fixed condensers were tried, *e.g.*, 0·0005 and 0·002 mfd., but it was

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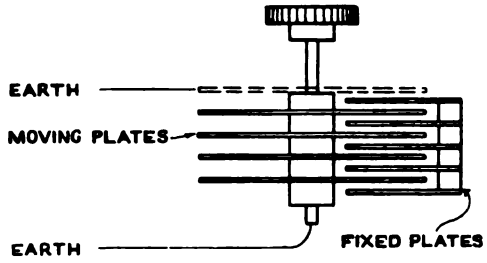


*Fig. 1. Variable condenser.*

found that whilst the former was satisfactory, giving critical adjustment for telephony, the wavelength range of the variable condenser was rather small, and when using the latter, it was impossible to critically tune-in telephony owing to the adjustment of the variable condenser being too coarse, and so a 0·001 mfd. fixed condenser is recommended.

The only other point of special interest in connection with the tuner unit is the shield over the variable condenser.

It is well known that the capacity effect of the hand in operating a condenser alters the tuning, and is especially noticeable with telephony where critical tuning is essential.

The reason for this is obvious when reference is made to Fig. 1.

Usually a variable condenser is manufactured with the fixed system overlapping the moving system, and the common practice is to connect the moving system to the earthed side of the circuit.

Now, when the hand is brought near the condenser it is equivalent to supplying another earthed plate to the moving system as shown dotted, consequently the capacity of the condenser is altered with a corresponding alteration in the wavelength.

The result is that very annoying characteristic of condenser tuning when a signal may be perfect with the hand on the condenser knob, but weakens or even disappears when the hand is taken away. And so a shield is introduced on the face plate of the panel which permanently provides the extra capacity to earth with the result that there is not the slightest difference in tuning, no matter in what position the operator's hand is.

Apart from these features the tuner unit introduces no special points.

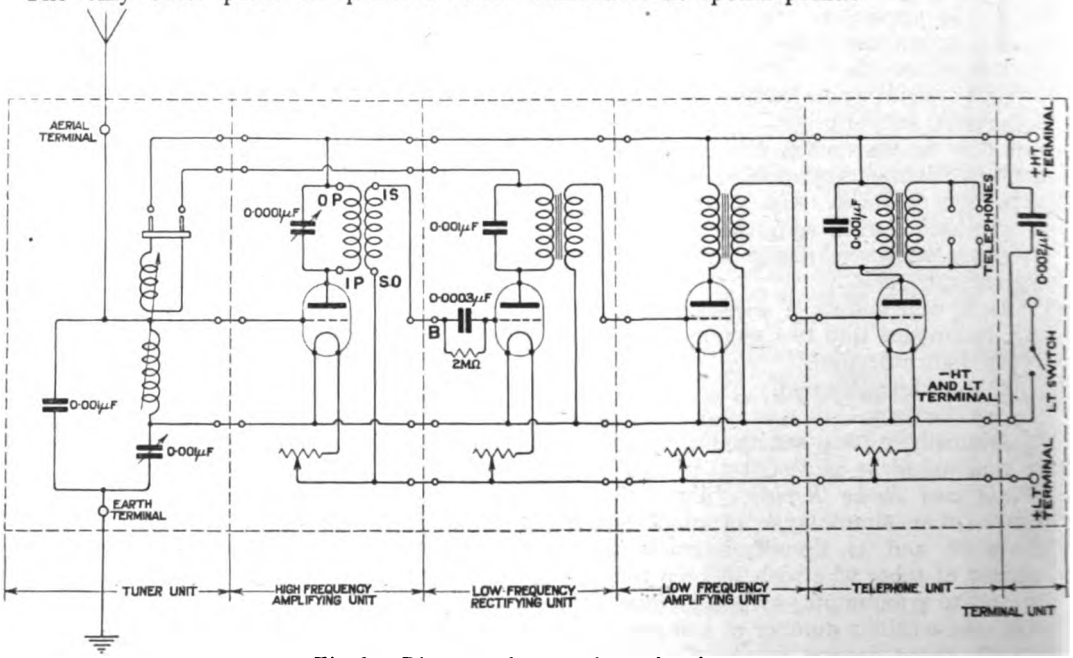


*Fig. 2. Diagram of connections of units.*

A small or vernier condenser is provided below and in parallel with the 0·001 mfd. variable condenser on the tuner unit for final adjustment, but in practice it has been found unnecessary, since the screening plate overcomes all critical adjustment troubles.

Fig. 2 shows a diagram of connections of the tuner with four-valve amplifier units, and Fig. 3 gives the principle dimensions of the tuner unit, whilst Fig. 4 shows a photographic view of this unit.

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In general, the units are designed to fit into the instrument section of a short wave tuner box and a width of $2\frac{3}{4}$ ins. was chosen as a general width of panel so that four of them would just fit into the box. With the tuner unit it was found necessary to increase the width to $4\frac{1}{4}$ ins., but it will be found that this odd dimension is brought to a multiple

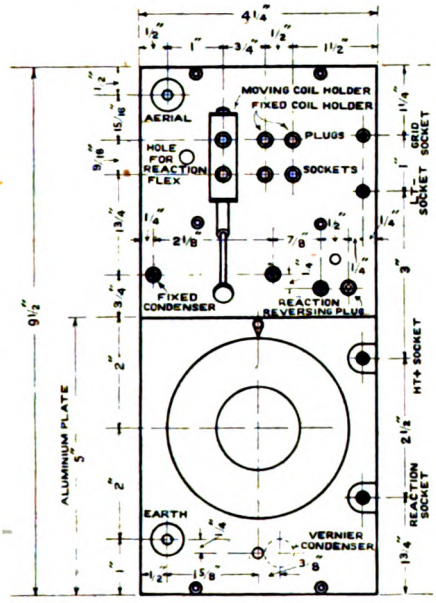


*Fig. 3. Dimensions of tuner unit.*

of $2\frac{3}{4}$ ins. by the terminal unit which is $1\frac{1}{4}$ ins. wide.

Adjacent panels are connected by means of small brass hoops or links which fit into link sockets on each panel, thus providing not only electrical, but also mechanical connection between panels.

DETAILS OF THE AMPLIFIER SECTION.

It has been stated above that for purposes of explanation four different types of amplifier units will be described, although of course it must be understood the unit system is adaptable for any method of valve coupling including resistance and reactance-capacity coupling, but in this article the more usual double wound transformer coupling is described.

The allocation of the various parts of the amplifier next comes under consideration, and perhaps this is the most important part in the design of any amplifier.

Usually the amateur designs an amplifier by sketching on paper how he can allocate the various items on a panel and giving no thought to the final connecting up of these components.

The result is that there is a maze of connections at the back of the panel with innumerable crossing of leads which gives a maximum number of leakage paths due to the condenser effect of the adjacent leads.

In this design the connections are considered first and positions of the various parts of apparatus are secondary.

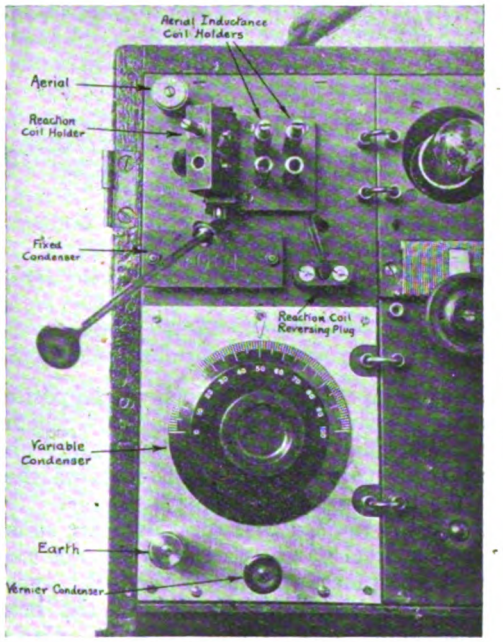


*Fig. 4. Details of tuner unit.*

If we look at the diagram Fig. 2 and take the telephone unit it will be seen that it is an advantage that :—

(1) The Grid Link be near the valve.
(2) The L.T. Negative Link be near the valve.
(3) The L.T. Positive Link be near the filament resistance.
(4) The H.T. Positive Link be near the transformer.
(5) The Phone Plugs be near the transformer.

Of course, in designing on the unit system, it is necessary to consider all the types of units that may be introduced, and keep in mind that certain parts which are not variable, such as the valve and iron core transformers, be placed as far away as possible from parts

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which are variable, such as filament resistances, condenser on H.F. unit, etc.

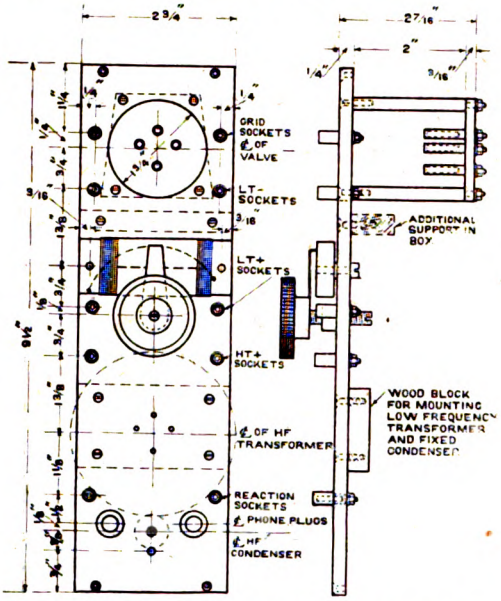


*Fig. 5. Showing position of apparatus on panels.*

Considering all these points, a composite drawing is evolved as shown in Fig. 5, which shows the position of *all* the apparatus on the various panels, whilst Fig. 6 shows the drilling of each respective panel.

It will be noticed that the valves are sunk below the level of the panel and yet not too far down to prevent the use of the "R" type of valve. This allows the lid of the box to be shut with the valves in place, and also it is an advantage that the

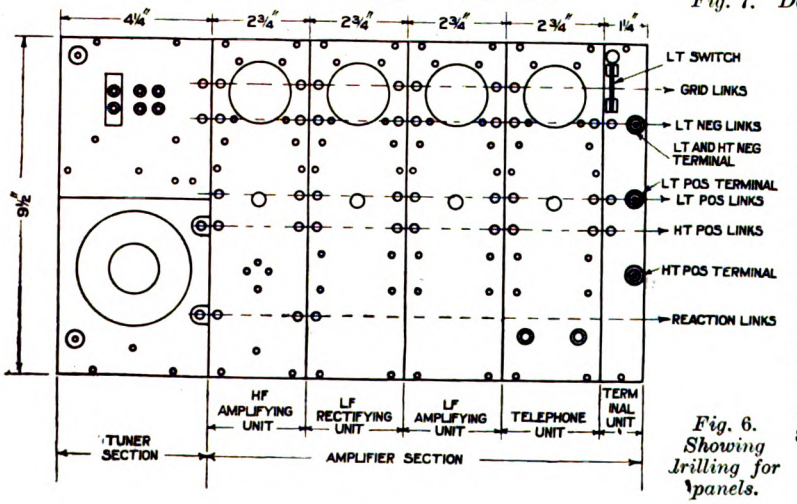


*Fig. 6. Showing drilling for panels.*

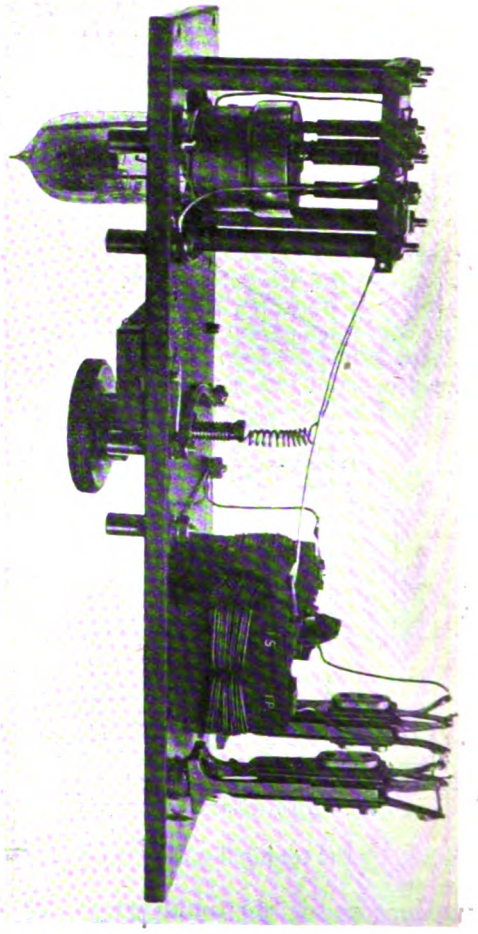

*Fig. 7. Details of telephone unit.*

connections from the valve leg sockets to the filament resistance and the transformer are in a different plane, or in other words are much lower than those connections immediately at the back of the panel. Thus, where any crossing does occur there is a distance of about 2 ins. between the leads.

Fig. 7, which gives the details of the telephone unit, shows this clearly.

*(To be concluded)*

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# On the Amplification of High-Frequency Currents

(*Continued from page 756.*)

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

A very simple modification of the arrangement shown in Fig. 11, page 756, gives us an amplifier which was invented by L. B. Turner, and called the "Kallirotron." The Kallirotron amplifier is actually this inverted Blondel amplifier (Fig. 10) with a back coupling. Turner's Kallirotron, as described by him* is shown in Fig. 12. In this case the two valves are coupled together by the same scheme as that just described, except that the potentiometer is not used, and an extra battery $B_3$ is employed, so that the grid of $V_2$ can be brought to the same potential as its filament, just as was done with the potentiometer in Fig. 10.

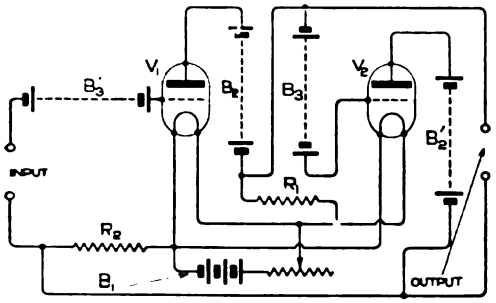


*Fig. 12. Turner's Kallirotron Amplifier.*

The Kallirotron also uses an exactly similar coupling from the anode circuit of the second valve back to the grid circuit of the first one, $V_1$. This therefore provides a back coupling from the second valve to the first for the amplified energy, so that it can be reamplified by the valves.

The Kallirotron, as described by Turner, is primarily a very sensitive amplifier, giving enormous amplification with two valves, an amplification of several thousands, since by reason of the back coupling effected by the resistances the apparatus can be got to the point where regenerative amplification is taking place, without it tending to oscillate readily, since there is nothing in the coupling in the nature of an oscillatory circuit, and there need be no oscillatory circuit connected to the anode of the second valve.

We thus see that Turner's Kallirotron and Blondel's amplifier, turned upside down in the manner here described, are identical except for the addition of the back coupling in the former. They form two rather uncommon methods of coupling two valves to enable them to amplify high frequency currents, and for that reason I have drawn your attention to them.

A scheme has been patented recently by Mr. Gossling, of the General Electric Company, slightly modifying this style of arrangement, so as to use one high tension battery only, but the circuits are much more complicated and involve the use of constant current resistances to keep constant the currents flowing round parts of the circuit. It is not an amplifier that can easily be set up for experimental purposes.

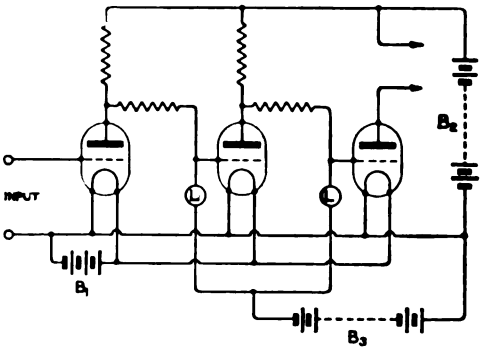


*Fig. 13. Gossling's Amplifier, using common batteries. L, L, = current limiting devices such as saturated valves.*

A diagram of one of these arrangements is reproduced in Fig. 13.

The next arrangement I wish to refer to is a very common form of coupling used between

* *Radio Review.* 1, pp. 317—329, April, 1920.

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two or more valves for the magnification of high frequency currents—viz., the resistance-capacity coupling which is sketched in Fig. 14. By putting an anode resistance between the terminals $T_1$ and $T_2$ of Fig. 6, and joining $T_2$ and $T_3$ we obtain the desired circuit. The anode resistance may be of the order of 50,000 to 100,000 ohms, and the leak from 1½ megohms to 4 or 5 megohms, according to the valve in use. Loss of amplification at high frequencies, to which I referred just now, also occurs with this arrangement. It is due to the stray capacities which must exist between different

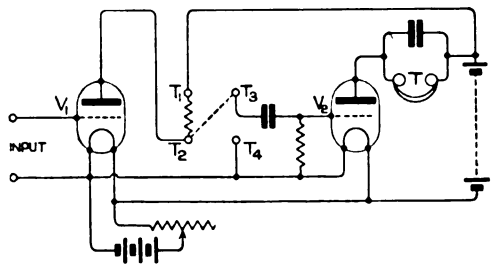


*Fig. 14. Resistance-Capacity Coupling arranged on experimental amplifier panel.*

points in the circuit. Any capacity across the anode resistance will shunt off the high frequency currents from that resistance, and will prevent their being passed on to the next grid. The H.T. battery should not have any appreciable resistance, but it is usually advantageous to shunt it with a condenser of one or more microfarads, so that the high frequency impulses will go through the condenser rather than through the battery.

It may be asked why it is necessary to have an anode resistance if its use creates difficulties. The reason, I think, will be obvious if we consider what it does in the circuit. If we apply a voltage to the grid of the first valve and if its anode is connected to the H.T. battery with no resistance in series, when the grid is made positive, the internal resistance of the valve will be lowered and a larger anode current will flow, but the anode potential is held constant by the battery and there is no point in the anode circuit where we can find an amplified change of voltage. In order to operate the second valve we need to so arrange the first that it will amplify the voltages applied to its grid so that these amplified voltages can be applied to the grid of the next valve. We can obtain the desired result by keeping the anode current constant, then whether we make the first grid positive or negative, we shall then get the corresponding changes in internal resistance of the valve repeated in the voltage changes across the terminals of the valve. Although the valve has a characteristic which is not entirely linear, and is therefore in consequence often said not to obey Ohm's Law of Current = Voltage divided by Resistance, this law applies rigorously for any given point on the characteristic, and the anode current is dependent upon the total resistance of the anode circuit, since the applied voltage from the H.T. battery is constant. The anode circuit resistance is partly made up by the valve and partly by the resistance of the outside circuit. If the internal resistance of the valve at any instant is $R_a$ the voltage across the valve will be the anode current $I_a$ multiplied by this resistance. Now if we can put in the circuit anything to keep the current practically constant, any change in $R_a$, the effective resistance of the valve, such as may be caused by changes in the grid potential applied to the valve, will be repeated in the voltage across the valve and will be applied to the grid of the next valve by means of the coupling condenser.

Supposing we want to keep this anode current constant, how can we do it? If we make the total resistance in the circuit constant, of course the current will remain constant. But here we have a constant supply voltage and a variable resistance, so that we cannot actually maintain the current quite constant, but we can get somewhere near it. If we make the remaining resistance in the circuit very large compared with the resistance of the valve, we can keep the current nearly constant. For example, if the valve has an internal resistance of 40,000 ohms, and we put in series with it four million ohms, the total resistance would be 4,040,000 ohms. If, then, this 40,000 ohms became 30,000 or 20,000, or even 60,000, it would only make one or two per cent. difference to the whole resistance value, and we would get the anode current almost constant. Any changes in the internal resistance of the valve would then be repeated as variations of voltage across the valve. Well, that could be done, but other points must be considered. Supposing that valve was passing a current of 1 milliampere, what voltage must be put in the anode circuit if we have to get 100 volts on the valve with one milliampere passing through the above-mentioned anode resistance? We should want 4,040 volts, which would be rather unpractical. Hence, when we are using resistance coupled

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amplifiers we have to make a compromise, since we cannot put anything like 4 megohms in the anode resistance, and we must put something of the order of 50,000 or 60,000 ohms so as to limit the total voltage which must be put into the anode circuit in order to get the necessary current through it. Then when we change our grid voltage we shall get a change in the anode voltage, but it will not be as big as if there were a very large series resistance. It is therefore not possible to hand on a voltage change to the next valve without introducing some loss in amplification, or in other words, the voltage amplification that will be obtained is less than it theoretically would be were the anode current maintained constant, by the voltage that is dropped by the current change through the series resistance.

Hence there are some practical disadvantages in the resistance-capacity coupling, and on that account attention has been given on many occasions to obtaining some other coupling method. The great advantage of the resistance-capacity coupling is that there is no part of the intervalve coupling which varies with the frequency (other than stray capacities), so that the amplifier is suitable for use on most frequencies, except when the stray capacities become troublesome.

By fitting up one of these amplifiers and connecting a variable condenser across the anode resistance, it is easily possible to demonstrate this loss in amplification due to the shunting off from the anode resistance of the high frequency amplified current changes. With very short wavelengths the loss due to that condenser becomes more and more important, because the current which it draws off from the resistance is proportional to the frequency.

In practical work with short wavelengths a means is wanted of getting over this difficulty. What we require is a method which will make the valve capacity and other stray capacities useful rather than harmful. We can do this if we make the capacity either tune or help to tune a circuit. This cannot be done with a resistance in the anode circuit, but if a coil is used instead of a resistance the circuit can be tuned. This effect can be obtained with a transformer coupling. For this we do not want a grid leak if the transformer is connected to the terminals $T_1$, $T_2$, $T_3$ and $T_4$ in Fig. 6, so that one coil is in the plate circuit of the first valve, and the other coil is in the grid circuit of the second, just like an ordinary transformer-coupled low frequency or note magnifying amplifier, except that a transformer suitable for the high frequency currents must be used. These connections are shown in Fig. 15.

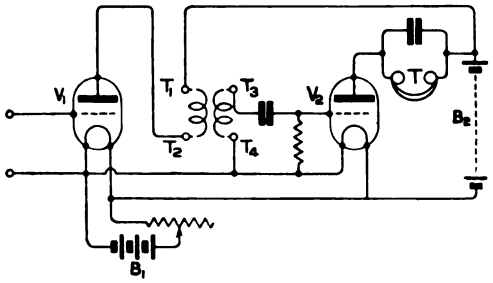


*Fig. 15. Transformer-Coupled H.F. Amplifier adapted to the experimental panel.*

Consider the effect of the valve capacity, which will behave as a condenser across the transformer winding. Obviously we obtain a tunable circuit, and therefore there will be maximum voltage across the transformer winding for one particular frequency.

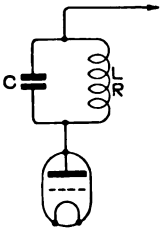


*Fig. 16. "Parallel Resonance" or "Rejector" Circuit in the anode circuit of a valve.*

The effective resistance of a parallel circuit of this type (Fig. 16) is an important quantity, because such a circuit at the frequency to which it is tuned behaves simply and solely as a non-inductive resistance. I do not know whether you are familiar with the vector representation of currents and voltages, but probably most of you have heard the statement that if you put an inductance in an A.C. circuit it makes the current lag behind the voltage, while if you put a condenser in it makes it lead the voltage, so that in the case of the parallel circuit sketched in Fig. 16, relative to the voltage across that circuit, the current through the inductance is lagging, and the current through the condenser is leading. Actually the inductance has some resistance,

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and the current does not lag at exactly 90° from the voltage; it lags at some less angle, such as 80° for example, as sketched at $\phi_1$ in Fig. 17. The vector representing the current through the condenser leads on the voltage by the angle $\phi_2$ which, with good condensers, is to all intents and purposes 90°. If we find the resultant of these two vectors by the usual parallelogram method, we find that its length is much less than either of the other current vectors, and that it is much more nearly in phase with voltage than is either of the other

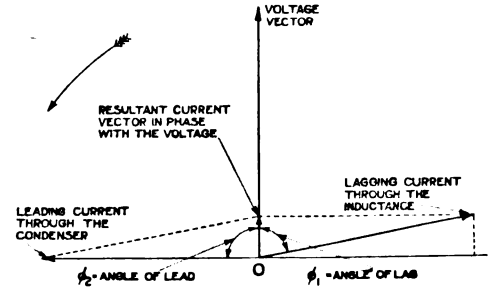
VOLTAGE VECTOR
RESULTANT CURRENT VECTOR IN PHASE WITH THE VOLTAGE
LAGGING CURRENT THROUGH THE INDUCTANCE
LEADING CURRENT THROUGH THE CONDENSER
$\phi_2$ - ANGLE OF LEAD
O
$\phi_1$ - ANGLE OF LAG

*Fig. 17. Vector diagram of "Parallel Resonance Circuit."*

current vectors. Obviously, therefore, it is possible to adjust the value of the leading vector representing the current through the condenser by altering its capacity until we arrive at a resultant vector which is in phase with the voltage. When that is the case the circuit is said to be tuned, or in resonance with the supply frequency. The total current through the circuit is then in phase with the voltage, although the currents in each branch of it are not in phase. I think by reference to Fig. 17 you can see that if this inductance is a bad one as an inductance, that is to say, it has a high resistance, and therefore does not make the current lag very much (such, for example, as when its resistance is approximately equal to its inductive reactance), then the resultant vector is quite large for a given voltage on the circuit. If the resultant current is large, the circuit has not a large effective resistance, although we have an inductance with a high resistance. If the inductance is good, so that it makes the current lag nearly 90° on the voltage, the resultant is very small, and the better we make our inductance, the less will be the size of the resultant vector. If we could get a perfect inductance we should have no resultant current flowing through the whole circuit, or in other words the effective resistance of the circuit would be infinite.

Actually the effective resistance of the circuit is represented by $R' = L/CR$, $R$ being the resistance of the coil, $L$ its inductance, and $C$ being the capacity of the condenser. That indicates that the higher the ratio of the inductance to the capacity the bigger is the effective resistance of the whole circuit, and if the ratio is small, the effective resistance of the whole circuit becomes smaller. Hence, if we use a good inductance, *i.e.*, a coil of low resistance and tune it by the valve capacity, or by the valve capacity plus a small variable condenser put on in parallel, we get an arrangement which, at a certain frequency, offers a very high resistance to the flow of alternating current through it, although as regards the D.C. high tension battery it is offering very little resistance. Hence we can in this way keep the steady voltage on the anode of the valve at its normal value, almost identical with the voltage of our battery, whereas at the particular wavelength to which the circuit is tuned, the effective resistance becomes very large, and therefore the changes in current flowing through the circuit become very small, and consequently a maximum alternating (H.F.) voltage is built up across the coil. Hence, under these conditions, if there is a maximum of voltage across the primary of the transformer there will likewise be a maximum of voltage across the secondary winding, since in all ordinary transformers of this type the coupling between the two windings is a close one.

Many types of high frequency intervalve transformers have been built for use in this manner. Those Mr. Campbell Swinton described recently at the Wireless Society of London were of this type, and were designed to operate on a range of wavelengths with a small tuning condenser across one of the windings.

In all these transformers, however, the two wires are wound close together so that actually these transformers act very little as true transformers. They are called transformers and wound as transformers, but they do not behave as transformers. To obtain true transformer action the two coils must be well separated out so that it is possible to tune the secondary as well as the primary, and in that way to build up in the secondary much higher voltages than we could obtain without such tuning. Thus by making this intervalve coupling like an ordinary loose coupled tuner with primary and secondary

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circuits both tuned, obviously we shall build up in the secondary circuit, when using a very small capacity, a maximum voltage and thus get large voltage amplification between the two stages of the amplifier.

When the two coils are wound as in the Sullivan and many other makes of H.F. transformer, and as in the transformers described by Mr. Campbell Swinton, the windings are so tightly coupled that they act as one circuit, and tuning one circuit tunes both. It does not much matter whether you tune only one circuit or tune both circuits simultaneously to get the desired wavelength, the result is the same. Thus when building up such an H.F. intervalve coupling transformer, it is not possible to tune up one of the circuits, or to adjust one of the circuits to the desired wavelength until the second winding is in place and joined up. For instance, with a transformer of this type adjusted to give maximum amplification on 600 metres, it will be found that the wavelength of the primary circuit alone, even when connected to the valve and other capacities, will be only 150 to 200 metres before the secondary winding is put on. Therefore an amplifier of this type must always be adjustedwhen thetransformers

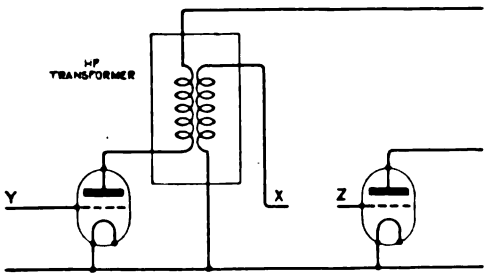


*Fig. 18. Method of adjusting wavelength of H.F. intervalve transformer.*

etc., are connected properly in circuit. A simple way of effecting this tuning is to take out the second valve from its socket and take back the wire X (Fig. 18) from the grid connection Z of the second valve, to the connection Y of the grid of the first valve. The first valve will then oscillate, and its wavelength can be measured, so that the transformer windings can be adjusted accordingly to give the desired wavelength. It is a very simple way to do it, and it works quite well in practice.

On account of the close coupling between them, the two windings thus behave as one coil, and although some of the energy is handed on to the next valve by ordinary transformer action, a considerable portion of the whole available energy is handed on by the electrostatic capacity between two windings.

In this case, therefore, we can obtain similar results by using one winding only and tuning it by means of a small variable condenser when, as I said just now, we get a maximum voltage built up across the coil

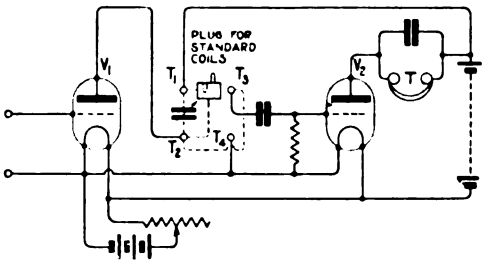


*Fig. 19. Arrangement of H.F. amplifier with interchangeable plug-in coils.*

when it is in tune with the working frequency. We then have only one circuit, one coil to tune, and can build up across it a voltage which is the maximum that it is possible to obtain, being limited only by the amplification factor of the valve, and the resistance of the coil winding. This, then, is a further simplification in the evolution of a simple high-frequency amplifier. With this change, however, we must once again introduce our grid leak, but the grid leak is not a very complicated piece of apparatus and it will do for all frequencies, and hence, whatever coils we use in the plate circuit of the valve, the result may come out in the end cheaper than having a series of special transformers. This is the case for the reason that you need not have any special coils for this purpose, but simply plug in to the anode circuit of the valve any convenient coil, such as a Burndept, or a Duolateral, or similar coil, and thus easily build up an amplifier in this simplified form. With the experimental panel arrangement that has already been described, the grid condenser and grid leak can be left in position and an ordinary standard coil plug connected in the anode circuit with a small variable condenser across it, as shown in Fig. 19. This condenser can have any desired value, but it is advisable to keep its maximum value small, say, 0·0001 to 0·0002 microfarad. We can then plug in any one of our standard coils into the circuit and make up an amplifier that will amplify any frequencies we like. It will amplify frequencies up to the highest



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it is possible to get in wireless circuits, and the maximum possible amplification can be obtained in this way.

With an amplifier of this type it is possible to demonstrate the physical reality of the above-mentioned expression for the effective resistance of the circuit by using a variable condenser of the ordinary type with a considerable range of capacity in the anode circuit of the valve and various plug-in coils. Either a large coil and a small value of condenser can be used or a small coil and a bigger condenser capacity, and the difference in the amplification often becomes quite pronounced, the small coil with the larger capacity giving weaker signals.

I have not so far said anything about introducing a reaction coil into the amplifier. This is easily done by inserting a suitable coil in the plate circuit of the detecting valve and bringing it back to couple on to the aerial circuit. It may also be pointed out that one need not with such an arrangement react back to the aerial circuit, but when using a tuned anode circuit of the type just described we can couple the reaction coil with our intervalve coupling coil and so make the detector valve oscillate without worrying so much about radiation from the aerial circuit.

One slight disadvantage of this type of amplifier is that some extra means is necessary for preventing self-oscillations of the high frequency valve. With most valves, tuning of the anode circuit to the same wavelength as that to which the grid is tuned, causes the valve to set up oscillations continuously, the reaction being provided by the inter-electrode capacities of the valve. The amplifier must therefore be stabilised, either by applying a positive voltage of 3 or 4 volts to the grid of the H.F. amplifying valve, or by dimming the filament, or by providing some form of *reverse* magnetic reaction to stop the oscillations. Either the first or the last of these methods is usually the more satisfactory.

Before concluding, I would like to refer to the additional problems which are involved in very short wave amplification. A great deal has been published about them and I thought it might be of interest to draw your attention to them.

As I have just indicated, the tuned anode H.F. amplifier can be made to amplify any frequency within reason so that it will amplify both long wave and short wave signals, provided the proper coils are used. Its one disadvantage in practical use is its selectivity; it mainly amplifies for the frequency to which it is tuned, and gives very little amplification for other wavelengths. When there is much jamming, this additional selectivity is useful. The tuning range can be broadened out a little and made to cover a wider band of wavelengths by using high resistance coils, which lowers the effective resistance of that circuit and broadens out the amplification over a wider range of wavelengths. The total amplification is somewhat reduced by this means, but at the same time it is broadened out so as to enable searching to be carried on over a wider range of wavelengths. The effective resistance of the circuit can be lowered by winding the coil of resistance wire, or by connecting a suitable resistance in series or in shunt to the coil. For many experimental purposes it is rather useful to connect up both a resistance-capacity coupling and this other tuned anode one, then if we want to search over a range of wavelengths we can switch in the resistance, and then when the signal is found we can make our arrangement much more selective and cut out some of the jamming if any is present.

For the amplification of very short wavelengths the arrangement which one can unquestionably recommend is either this tuned anode or the tuned transformer used in conjunction with the principle of Armstrong's supersonic heterodyne, that is to say heterodyning the incoming signals not to give an audible note in the telephones as one ordinarily does, but heterodyning to a much higher frequency, and then amplifying this intermediate frequency by some other form of radio-frequency amplifier. Thus for the reception of 200 metre signals, we can set our heterodyne to about 214 metres, thus giving us a beat note or heterodyne note frequency of 100,000 cycles. We cannot hear a note of 100,000 cycles, but it is an oscillation of 3,000 metres wavelength. Thus with this scheme we can heterodyne our incoming signal to a longer wave signal and then amplify it in the ordinary way, finally obtaining an audible note with a second separate heterodyne.

I do not know whether the members present have seen the description of the apparatus used by Mr. Godley, the American who was sent over here in connection with the Transatlantic Tests, but he used such a scheme with a nine-valve amplifier, the first one being a detector valve and the next one a high frequency oscillator, using the remaining set of valves for the long wave amplification, for detection

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of the long wave signals with a note magnifying valve at the end.

This Armstrong super-heterodyne does enable you to get very high amplifications on very short wavelengths, and although amateur experimenters in this country have up to the present mostly confined their transmissions to 1,000 metres, there are considerable advantages in the prevention or reduction of jamming between various stations in using the shorter wavelengths round about 180 metres, which most of us are licensed to use. If we should develop the use of such wavelengths it might be important to consider such a scheme as the Armstrong super-heterodyne.

# Is News by Wireless Really Wanted?

By CAPTAIN IAN FRASER.

NEWSPAPER reports from America, and evidence from various quarters in this country, make it clear that in the not far distant future the broadcasting of wireless telephony to thousands of homes will become a feature of life in England. Mr. Kellaway's statement in the House of Commons the other day indicated that a settlement of the dispute that had arisen between the Post Office and the various firms who desired to manufacture wireless receiving sets was in sight, and this of course brings very near at hand the day when broadcasting in the United Kingdom will become a reality.

Without doubt there will be a boom in this country in the sale of wireless receiving sets, and a gallant attempt will be made by the firms who undertake broadcasting to supply an interesting and useful service of news, concerts, etc.

I write this article because I believe that the profuse publicity which has been given to this new development in the science of wireless telephony has led the man in the street to an entirely wrong conception of its usefulness. I believe that the novelty and wonder of receiving news from a distant source without any visible means of connection between the sender and the receiver has filled people with an exaggerated view of the value and usefulness of such a service.

That news can be transmitted and received simultaneously in thousands of homes I know, of course, and that the reception, with only a moderate outlay for apparatus, can be really good, I know too, from personal experience. But I venture to think that when calculating the development of a news service by wireless telephony one very important factor has been overlooked, and this factor occurs to me with unusual emphasis on account of the fact that I have been compelled to receive all my news by means of the ear instead of by means of the eye for the past five years. I was blinded at the battle of the Somme in 1916, and since that time, though I have kept very closely in touch with the news of the great world outside, I have had it brought home to me every day what a clumsy and inefficient organ the ear is for this purpose, as compared with the eye. And yet I who have had to listen for my news have had two great advantages over him who proposes to hear it through a wireless telephone receiver. Firstly, I am able to have the newspapers read when I desire to hear them, and not at a particular time, such as would be imposed upon the listener to a broadcasted news service which at best could only be convenient to the majority of the listeners, and not to the individual. Secondly, my reader can pick out the particular newspapers which I like to hear, and by reading through the headlines and waiting for me to say yes, or no, before proceeding with the article or paragraph, can approximate in some measure to the efficiency and facility with which a sighted person glances at his paper and chooses what he wishes to read. I have a Secretary who can read to me at from 240 to 250 words a minute. There are probably quite a number of people who can read aloud well at this speed, but there are not many who can listen to it, and take in what is being read. People who can see are not used to having books

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or newspapers read aloud to them, and without long practice I do not believe the ear and brain could be expected to take in information read at anything like this rate. However, supposing with practice the many thousands of people whom we are lead to believe are going to receive their news by wireless telephony attain this speed, they will still be spending twice or thrice as much time in gathering any particular piece of news than would be required if the eyes were used.

I do not deny that there may be some hundreds of people living in the country who desire to hear some particular piece of news which the broadcasting station will send them at a particular time, and who—desiring it sufficiently much to make them put up with the inconvenience of listening to it, or perhaps not being able to obtain a newspaper for some hours after the event—will become regular users of the system. For example there will undoubtedly be a regular service announcing the winners of races, and as there are no regular evening papers in the depth of the country there will be a number of people who would be willing to install a wireless telephone receiver for the purpose of receiving this information earlier than would otherwise be possible, with the additional attraction, of course, of having concerts available in their homes.

But, comparatively speaking, these people will not be very numerous, and I am therefore strongly of the opinion that when the initial interest has evaporated it will be found that the news service by wireless telephony is not wanted.

The acceptance of this theory would lead to a reduction of the estimate which would otherwise be made as to the number of wireless receiving sets which will remain in use after the first novelty which led to their installation has passed away. But it by no means indicates that there is nothing in the idea of broadcasted wireless telephony.

In my view there will always be a demand for broadcasted wireless telephony, if a really first class concert, and occasional lectures and perhaps speeches by eminent politicians or others on matters of interest and importance are supplied.

And this will be much more the case when the science of amplified or loud-speaking telephony reaches a stage when it is possible to throw the speech or music received by the wireless instruments into a small sized drawing-room or sitting-room without much cost or difficulty. At the present time this stage has not been reached, for whereas instruments for the reception of wireless telephony with headphone can be purchased for a few pounds, the outlay is two or three times as much if a volume of sound comparable with that given by an ordinary gramophone is desired.

With the best amplifying apparatus concert items can be produced as loudly or even more loudly than by gramophone, and rather more perfectly, for there is usually an entire absence of the mechanical noises which take away from the perfection of the best gramophone record. Further, with the concert item transmitted by wireless telephony there is, I think, a curious psychological effect. Though it does not sound very different from the rendering of a record by a gramophone, the listener has nevertheless a feeling that there is more vitality about it. This is probably so because he is conscious of the fact that almost at the moment of listening the living artist is performing, whereas with the gramophone, however good it may be, there is ever present the thought that the particular rendering to which he is listening is not new, and is not a thing of the present. If one were permitted to use the phrase in connection with the mechanical production of the human voice or the strains of an instrument one would say that there is more personality in the wireless concert item than the gramophone record.

**THE WIRELESS EXHIBITION AND CONVENTION**

**SEPTEMBER 30th TO OCTOBER 7th, 1922**

**AT THE HORTICULTURAL HALL**

**WESTMINSTER, S.W.**

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# Experimental Station Design

*Continued from page 719, September 2nd, 1922.*

***These articles, which appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the Experimental Station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions are given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.***

***Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.***

***The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony, and consequently may cover ground already familiar to many readers. The succeeding instalments, however, advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.***

## XII.—HIGH FREQUENCY AMPLIFIERS.

SUGGESTED methods for incorporating the high frequency transformers already described, in high frequency amplifiers are shown in Figs. 1 and 3. Easy modifications can be effected for making use of any particular type of transformer, though with transformers of bigger external diameter than those shown a larger ebonite panel will have to be used in order to obtain sufficient spacing to prevent inter-action, which is a common

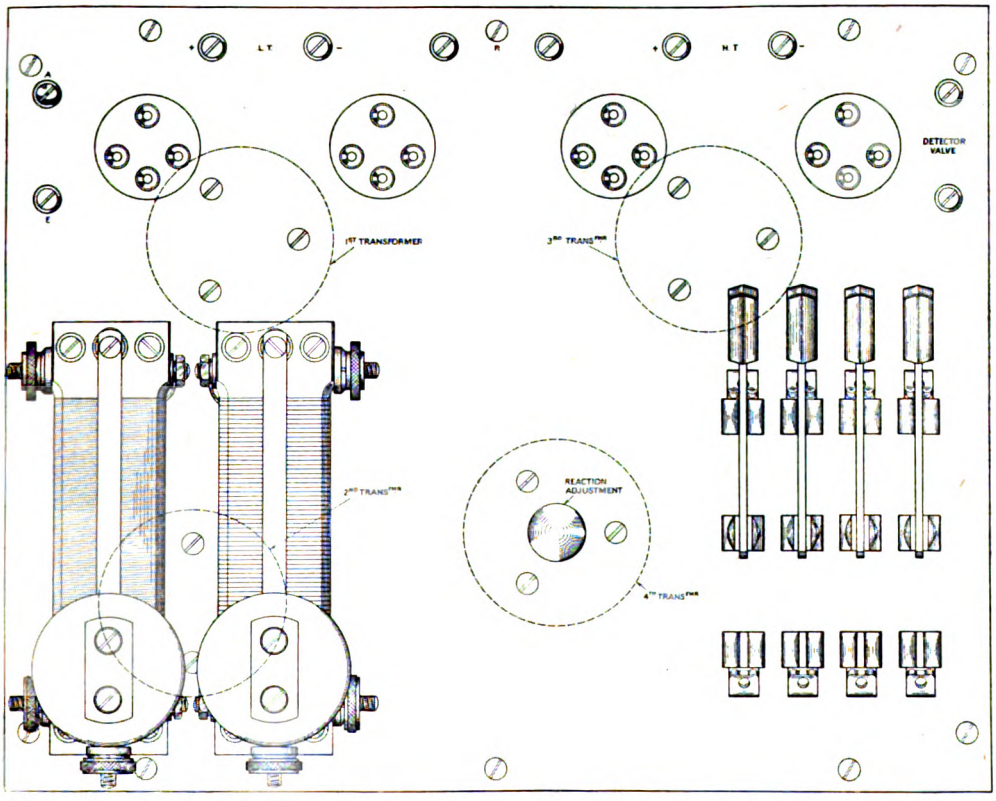


*Fig. 1. Lay-out of panel of H.F. Amplifier provided with valve switching and reaction designed for use with "R" valves. Scale ½ actual size.*

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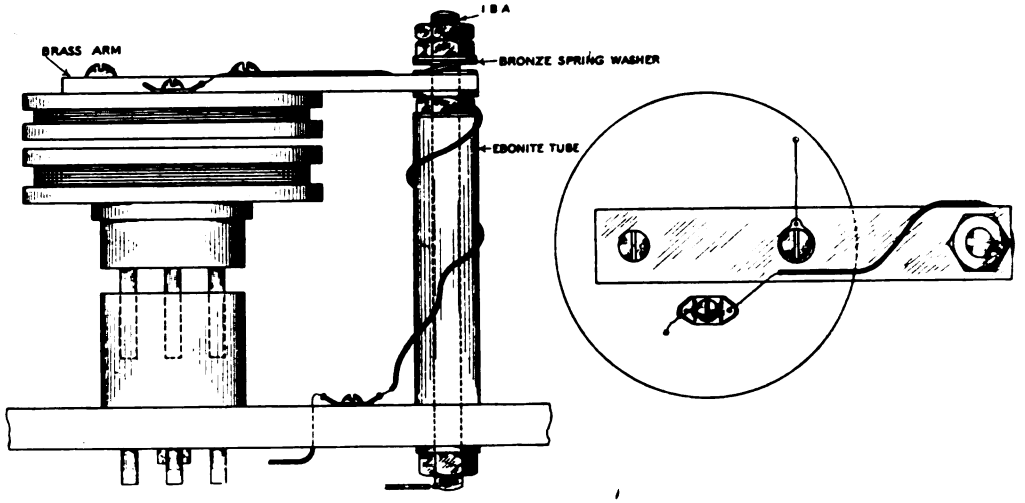


*Fig. 2. Front and side views of plug-in transformer with swinging reaction coil. Scale ¼ actual size.*

cause of parasitic noises. The drawings are made to scale, and the transformer spacing is ample for the types shown. If many stages of amplification are to be employed, the reader is advised to use transformers of small diameter in order to limit the dimensions of the panel on which they are to be mounted. Panels of the sizes illustrated may be $\frac{5}{16}$ in. in thickness, but should any increase in area be necessary the thickness of the ebonite should be correspondingly increased to $\frac{3}{8}$ in. Other modifications may be necessary when purchased components are made use of, should they differ in size from those shown. For instance, should purchased rheostats be larger in diameter, they should be laid out on a sheet of paper and carefully measured in order to ascertain the increase in length and breadth of the panel, and careful consideration given to margin and spacing, if symmetry is desired.

The design given in Fig. 1 is for the use

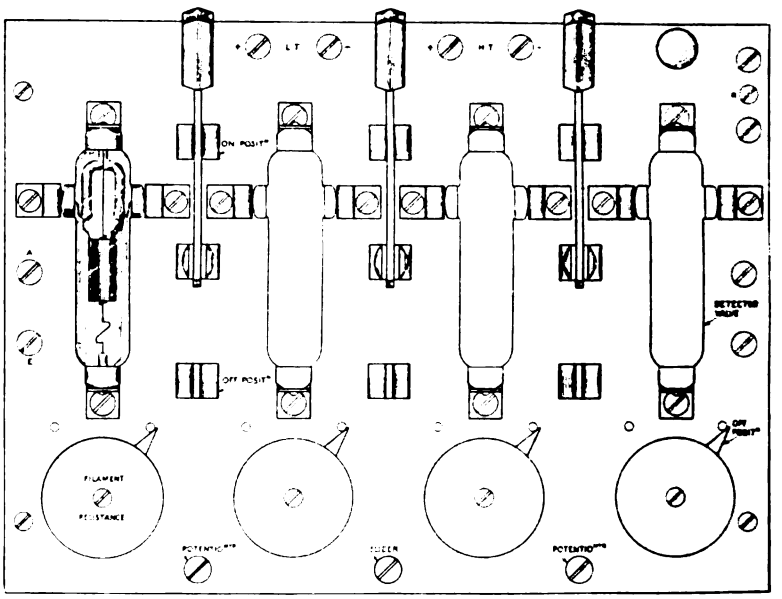

*Fig. 3. 4-Valve amplifier using valves of the "V 24" type, and having separate filament control for each valve. Scale ¼ actual size.*

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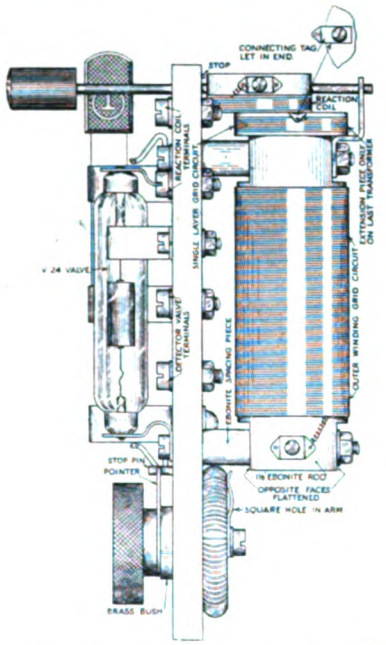


*Fig. 4. Side view of Amplifier employing "V.24" valves. Scale ¼ actual size.*

of valves with the "R" type socket, and it is intended that it should form the lid of a shallow box, that is, the amplifier will be operated in a horizontal position. Its transformers are shown in Fig. 6, page 718, only the last one in circuit being fitted with sliding reaction coil. Scratch marks are made on the brass rod which operates the reaction to indicate the extent of coupling of the reaction coil. The filament current of all valves is controlled by a rheostat common to all, and a potentiometer is fitted for controlling the grid potentials which is a very essential feature in the design of a multi-valve H.F. amplifier. Its critical adjustment will not only result in maximum amplification, but will give additional control for the elimination of howling. With certain types of valves, however, it may not be found essential, but when omitted, terminals should be fitted to permit of its introduction. For this purpose the transformer secondary leads must be joined together and taken to a terminal which can be strapped across to another terminal which is connected to the junction between filaments and filament resistance, the resistance being connected in the negative lead of the battery. The rheostats and switch parts shown are of well-known types, the latter having been removed from their china bases. The four switches in the four-valve set provide for throwing all valves out of circuit in any order, but where it is desired to keep reaction always in circuit it will not be necessary to switch off the last valve, and consequently one switch less than the number of valves only, will be needed.

The wiring up may be very much simplified by omitting the switches, but the use of a varying number of valves is always a great convenience, particularly where filament current is a consideration, and moreover, switching permits of the testing of valves and transformers

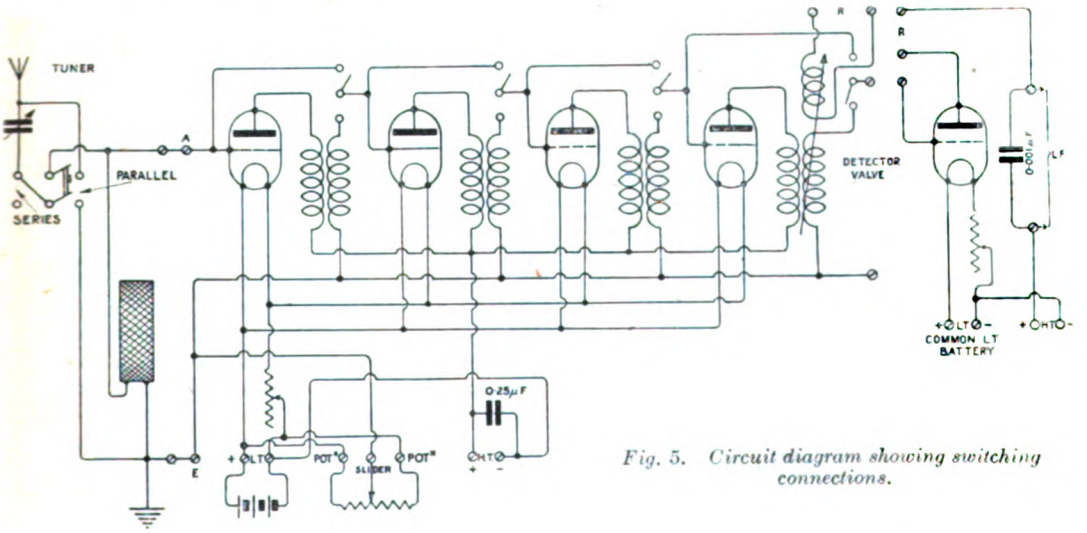


*Fig. 5. Circuit diagram showing switching connections.*

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one against another. When making use of the interchangeable transformers of the plug-in type, the panel may be operated in a vertical position, and an ebonite top piece with valve holders may be arranged to take the valves, whilst those on the front may now carry the transformers. A method of arranging reaction in this case is shown in Fig. 2. It consists of a bracket carrying a swinging brass arm, to which is attached either a slab inductance or a turned ebonite disc with groove to carry a winding. The pillar consists of a piece

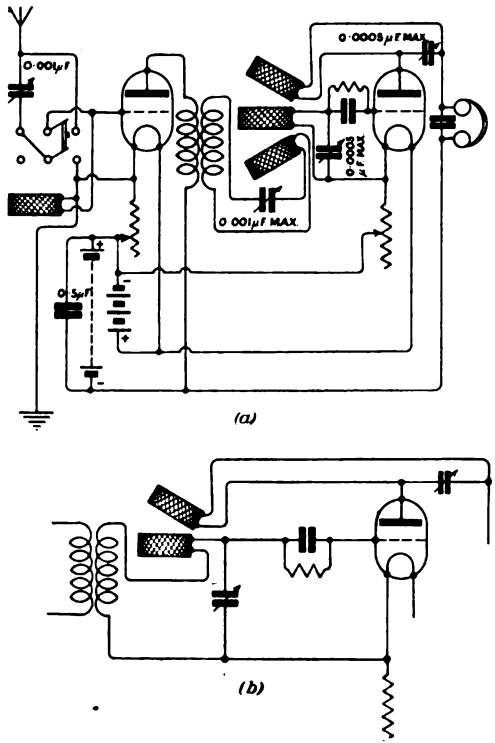


*Fig. 6. Circuit diagram showing method of arranging reaction after H.F. amplification.*

of ½-in. ebonite or fibre tube with ¼-in. hole through which is passed a piece of ¼-in. brass rod. Washers and nuts clamp it securely to the panel, whilst an additional nut and spring washer serve to make a friction turning point for the arm. The spindle may serve to carry contact from the coil to the internal connections of the instrument together with a flexible lead wrapped round arm and pillar and passing through a hole by its base. In mounting this on the front of the panel the arm should be vertical at the position of half-coupling so as to obviate any tendency it may have to drop round owing to insufficient friction.

Fig. 3 is a design suitable for use with valves of the "V24" type, which are specially intended to function efficiently in high frequency amplifying circuits. Separate filament control is arranged which has the advantage of allowing for individual adjustment for each valve, and in addition, the brightness of filaments left in the circuit will not fluctuate when other valves are switched off. Filament resistances should always have an "off" position. The transformers used are similar to those shown in Fig. 2, page 716. To take up less space, the transformers are arranged parallel to the face of the panel, and are attached by means of long 3 B.A. screws, which also serve to attach the spring clips for holding the valves. The clips can be made from No. 22 × ⅜ in. wide phosphor bronze strip. The dimensions of the transformers are as shown in the drawing, there being sufficient length for winding up to 600 turns of No. 40 S.S.C. in a single layer. In spite of the very tight coupling between primaries and secondaries, it is advisable to make the inside winding the plate circuit to prevent inter-action between the transformers. The side view (Fig. 4) shows the method of mounting the transformers, and in particular, the sliding inductance for providing reaction. This consists of a small piece of circular ebonite carefully drilled right through to carry the adjusting rod which is held in place by a set screw or pin. It slides over the end of the transformer, making light contact in order to prevent it turning. A piece of stiff brass held down under the nut which clamps up the transformer forms a bracket to act as a guide for the rod. Flats are filed on opposite faces of the transformer formers, and spacing is effected by small pieces of ebonite tube. If the reader cannot obtain screws sufficiently long for holding the transformers he will, of course, tap a piece of $\frac{3}{16}$-in. brass rod with a 2 B.A. thread and use nuts at both ends. In the transformer shown it is the outside winding that is the grid circuit, which is extended so as to be coupled to the reaction coil. The reaction winding should consist of a single layer of No. 42 S.S.C. for use on short wavelengths, and be extended as near to the edge as is possible. A convenient way of terminating the lower end of this winding is to make a hole vertically through its former connected to a slight recess on the under side. The lead can be sealed in with a little hard wax. If the reaction effects are too great,

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even at the position of minimum coupling, a few turns may be removed from the top end of the transformer or, alternatively, the end portion may be wound with slightly heavier gauge wire. If insufficient coupling is obtained, though this is improbable if the right type of valve is used, it can be increased by very cautiously piling the end turns of both transformer and reaction coil.

Fig. 5 is the wiring diagram showing the joining up of the switches. Using transformers operative over a wide band of wavelengths, very little is gained excepting, perhaps, a step-up of potential when only a few turns are used in the aerial circuit for tuning. With this type of circuit, as with crystal circuits, where there is no reaction directly coupled back, a certain amount of efficiency is lost by the use of a series condenser, though, of course, circumstances may be such that its use is essential to tune down to a desired wavelength. Instead of providing reaction in the amplifier itself, the amplified oscillations may be passed to an inductance to which is coupled a reaction inductance. In this case, the secondary of the last transformer is only about one quarter the turns of its primary, and the coupling between primary and secondary, somewhat loosened by increased spacing. F.H.H.

# Electrons, Electric Waves and Wireless Telephony

## A SERIES OF ARTICLES BY DR. J. A. FLEMING, F.R.S., SHORTLY TO COMMENCE IN THIS JOURNAL.

DR. J. A. FLEMING requires no introduction to readers of this journal. His work in connection with "wireless" stands out so prominently that his name is associated with almost every phase in the development of the science.

In addition to his most unusual scientific capabilities, Dr. Fleming is at the same time extraordinarily popular as a lecturer. It would be difficult to imagine a more enthusiastic audience than that which filled to overflowing the lecture theatre of the Royal Institution on the occasion of the series of lectures delivered by Dr. Fleming last Christmas, the subject being "Electric Waves and Wireless Telephony." These lectures dealt in succession with waves in various media and concluded with a delightfully clear exposition of the propagation of electric waves in the aether and wireless telephonic speech.

At the present time, with the prospect of a wonderful development in the popularity and usefulness of wireless telephony resulting from the advent of broadcasting, there is probably no subject which is calculated to make a stronger appeal than a lucid explanation of wireless telephony introduced with an explanation of wave formation and an insight into modern views on the nature of atoms, electrons and the aether—that hypothetical medium invoked as a basis for the propagation of wireless waves.

It is with considerable pleasure, therefore, that we are able to announce that the lectures delivered before the Royal Institution are to form the basis for a series of articles which this journal has been fortunate in securing from the pen of Dr. Fleming, entitled "Electrons, Electric Waves and Wireless Telephony."

The series will be commenced in the issue of *The Wireless World and Radio Review* for October 7th, which will be the first number of the second half-yearly volume. This series will form the distinctive feature of the volume and there is no doubt that it will constitute one of the most attractive contributions yet made to wireless literatue.

The articles will be elaborately illustrated with figures and diagrams, and whilst they will cover the subject in the fullest detail, the gradual development from one phase to another will ensure that even the new reader is never carried out of his depth.

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# The Damp-Proofing of Coils and Formers

By G. P. KENDALL, B.Sc.

ONE of the most important factors in the efficiency of a receiver is the proper damp-proofing of the tuner windings and formers, for upon this depends the constancy of the results obtained. Many of those annoying vagaries of fluctuating signal strength of which beginners sometimes complain can be laid at the door of damp in the coils or the tubes upon which they are wound. It is therefore a matter of considerable importance to make a correct choice of an insulating and proofing agent, and to use an effective method of impregnation.

Those amateur constructors who can afford to use ebonite tubes for their inductances will find it a fairly simple matter to render their windings damp-proof. The former itself being impervious, all that is necessary is to impregnate the cotton or silk covering of the wire, and shellac varnish is perhaps the most convenient agent. It gives very good results, provided that it is thoroughly dried by baking, and that varnish of good quality is used. This last should be noted; the varnish should be obtained from an electrical firm, and not from an ordinary paint and colour merchant, whose product may have very poor insulating properties.

The necessary baking of the varnished coil should be done about ten minutes after the application of the shellac, and should be carried out in a *moderately* hot oven. Care must be taken not to overheat the coil, lest the ebonite tube be damaged or the varnish scorched.

Most amateurs, however, regard ebonite tubes as much too expensive for ordinary purposes, and therefore use cardboard ones. The substitution is justifiable, and does not lead to appreciable loss of efficiency *if* tube and winding are properly impregnated. Shellac is not quite so suitable in this case, since it is difficult to get it to soak well into the cardboard. Paraffin wax is the better material for treating formers of this type, because the tube with the coil upon it can be soaked in a bath of the melted wax until throughly impregnated. To obtain the best results with this material there are one or two points to be noted, however. First, care must be taken not to heat it too fiercely or it may "scorch," or, when melted, boil. Should it be allowed by accident to boil, take it off the fire and keep it away from lights until it has stopped (it gives off considerable quantities of inflammable vapour when boiling). Second, it should be realised that it is possible by means of the wax bath to expel moisture from the cardboard and the covering of the wire and to replace it with wax, provided that the wax is heated to a temperature above the boiling point of water. If it is raised to, say, 130° centigrade the water will be driven out as steam, bubbles of which can be seen rising through the wax. When the bubbles come to an end the process is complete and the coil can be taken out, drained as completely as possible, and put aside to cool.

The careful worker uses a thermometer for these operations, but for the benefit of those who do not possess a suitable centigrade thermometer, and do not care to go to the expense of buying one, it may be as well to explain that the desired end can be attained fairly well by heating the wax in some form of double boiler, such as a jam-pot standing in a saucepan. If the outer vessel is filled with very strong brine and kept boiling briskly, a temperature will be reached in the inner one which will be capable of expelling moisture if given time.

The preceding notes have particular reference to single-layer windings, and they should not be applied too literally to all coils. It is very difficult to bake the moisture out of some types of multi-layer coils, such for example as those produced by pile-winding, and for these the wax bath should be used. In general, the experimenter must use his judgment to decide which is the method best suited to a particular case.

It should be remembered that all the insulating materials used for impregnation purposes have a fairly high dielectric constant, and hence they increase the internal capacity of the coil somewhat. To keep this objectionable increase down as much as possible be very sparing with your varnish and wax; use only just sufficient varnish to completely impregnate the covering of the wire, and in the case of wax, drain off as much as you can when lifting out the coil.

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# The Wireless Society of London

## RESUMPTION OF MEETINGS AND WORK IN HAND.

WEDNESDAY, September 27th, is the date fixed for the opening meeting of the new session of The Wireless Society of London. The meeting will be held at 6 p.m. on this date at the Institute of Electrical Engineers, Victoria Embankment.

During the summer vacation, although general meetings have not been held, it should not be supposed that the activities of The Wireless Society of London have been curtailed The Officers and Committee have met together, as occasion required, and have kept in view many points of general interest, and have taken every step necessary to keep in touch with the events which have been happening during the past few months.

At the General Meeting to be held on September 27th, it is hoped that Senatore Marconi will be present to address the meeting. Senatore Marconi, who is at present in Italy, has promised to be present if he returns to England in time.

### BUSINESS OF THE OPENING MEETING.

Among the matters which will receive special attention at this meeting will be the subject of Broadcasting, and also the forthcoming All-British Wireless Exhibition to be held at the Horticultural Hall from September 30th to October 7th.

The President, Admiral of the Fleet Sir Henry B. Jackson, has promised to make an announcement with regard to certain resolutions passed at the recent Conference held in Brussels, at which Conference he represented Great Britain.

### FUTURE MEETINGS OF THE SESSION.

The Society is again indebted to the Council of the Institute of Electrical Engineers for having kindly placed the Lecture Hall of the Institute at the disposal of the Society for their monthly lectures.

Arrangements have been made for lectures to be held in that building on the fourth Wednesday in each month until the close of the new session in June, 1923 Particulars of lectures to be held will be announced as far in advance as possible

On October 25th, a joint lecture will be given by Mr. R. S. Smith Rose, and Mr. R. H. Barfield of the National Physical Laboratory, the subject of the lecture being " The Effect of Underground Metal Work on Radio Direction Finders."

### THE ALL-BRITISH WIRELESS EXHIBITION.

Some further information regarding the All-British Wireless Exhibition, and the arrangements made by this Society in connection therewith, may be of interest. A special room at the Horticultural Hall has been placed at the disposal of the Society for the purpose of short popular lectures on wireless each afternoon and evening during the period of the Exhibition.

The Hon. Secretary will appreciate the offer of assistance in this direction from any member of the Society or affiliated societies who is not already in correspondence with him on the subject.

This room will serve also for the purpose of social meetings for members of this Society and members and officers of affiliated societies.

The Hon. Secretary of the Wireless Society of London will appreciate a notification beforehand from the Hon. Secretaries of Societies who may arrange for parties to visit the Exhibition.

### AFFILIATION OF SOCIETIES AND ENROLMENT OF NEW MEMBERS.

The Committee are pleased to report that many new societies and clubs have applied for affiliation and have been accepted.

The Hon Secretaries of new societies and clubs are asked to write for particulars of affiliation to the Hon. Secretary, Mr. L. McMichael, 32, Quex Road, N.W.6, and the same invitation is extended to those who are desirous of becoming Members or Associate Members of the Society.

Since the last session the following societies have been accepted for affiliation. :—

Middlesbrough and District Wireless Society.
Ilford and District Radio Society.
Shrewsbury and District Radio Society.

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Ramsgate, Broadstairs and District Wireless Society.
Redhill and Reigate Wireless Society.
Durham City and District Wireless Club.
Smethwick Wireless Society.
Bishop's Stortford Wireless Society.
Radio Club de Brussels, Belgium.
Malta Radio Society.

In addition, a large number of new members and associate members will be balloted for at the General Meeting on September 27th.

AMATEUR TRANSATLANTIC TRANSMISSIONS.

In connection with Amateur Transatlantic Transmissions, the Society has certain announcements to make. By way of introducing the subject it may be of interest to quote from a letter received by the Hon. Secretary of the Wireless Society of London from Mr. F. H. Schnell, Traffic Manager of the American Radio Relay League.

The following is a quotation from Mr. Schnell's letter :—

" In view of the success of our Transatlantic Tests of December, 1921, we desire to conduct another series of tests to include transmission from American and Canadian Amateur Stations, and, if possible, the reception of signals from British and French Amateur Stations

" Arrangements can be made with the Dutch Amateurs for reception and with the French Amateurs for both transmission and reception.

" I am taking the liberty of writing the Wireless Society of London with the purpose of determining with what British organisation arrangements should be made to handle the tests in England."

In view of this application on the part of the American Radio Relay League for the co-operation of the Wireless Society of London in the conduct of Transatlantic transmissions, the Committee of the Society has undertaken to co-operate in the arrangements for the transmission, which will be controlled by amateurs in this country.

It is understood that the Manchester Wireless Society has already made good progress with the erection of a station for Transatlantic amateur communication, and that they will shortly be in a position to conduct preliminary tests.

Arrangements are being made by the Wireless Society of London for transmissions by amateurs to take place from a station in or near London, and further announcements regarding this matter will be made shortly.

A committee has been appointed to deal with this subject and the names of those who will serve on this committee are: Major H. Hamilton, D.S.O., Commander C. F. Phillips, A.M.I.E.E., Mr. P. R. Coursey, B.Sc., A.M.I.E.E., Mr. G. G. Blake, M.I.E.E., and Capt. Norman Lea, B.Sc., A.M.I.E.E.

Mr. W H. Shortt has resigned from the Committee of the Wireless Society of London, as, having left London, he finds it impossible to give the necessary time to the affairs of the Society. The Committee have invited Mr H. S. Pocock, who is the Editor of *The Wireless World and Radio Review*, the official organ of the Wireless Society of London, to fill the vacancy on the Committee.

*All communications regarding the Society should be addressed to the undersigned :—*

L. MCMICHAEL
(Hon. Secretary, Wireless Society of London),
32, Quex Road, W Hampstead, N.W 6.

**DO NOT FORGET THESE DATES!**

**September 30th to October 7th, 1922.**

**The All-British Wireless Exhibition,**
**Horticultural Hall, Westminster, S.W.**

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# Air Race Reports.

## BROADCASTING BY 2LO AND RECEPTION EVERYWHERE SUCCESSFUL.

FROM all over the country letters and telegrams from amateurs describing their reception of the air race reports pour in. There is not a doubt that the arrangements were satisfactorily carried out and reception was possible, so clearly that all the excitement of the race could be enjoyed. Reports were made by the Air Ministry on behalf of the Royal Aero Club from various places along the 800 miles course, which ran through Birmingham, Newcastle, Glasgow, Manchester, Bristol and back to Croydon. The reports were received at the Marconi Broadcasting station, and within a few minutes of their reception were broadcasted.

As far as the wireless arrangements were concerned, both as regards transmission and reception, the event was highly interesting. This was broadcasting. Moreover, it was broadcasting of news but a few minutes old. As an experiment there was complete success, but, of course, these are early days in broadcasting, and what may be possible in the near future is but foretasted as yet.

It must be borne in mind that the event reported did not take place on a small field. A report of a football match which could be watched and the information provided by one person from one instrument would be a very much more simple problem than that of reporting during progress the events taking place on so large a course as was covered by the aeroplanes competing for the King's Cup.

In the first place considerable organisation was necessary. But although the scheme was a big one, complications were avoided as far as possible. Of course, like all new things, there was a certain amount of experiment in the effort, and the Air Ministry and 2LO were working on new ground. Fortunately, atmospheric conditions in most places did not seriously interfere with the reception, and from the reports which were asked for, of the transmissions, it is obvious that a good deal of keenness prevailed.

One telegram from Diss, in Norfolk, stated that the transmissions had been duly heard on a simple crystal set, using a P.M.G. twin aerial. Considering the distance this was an excellent performance. Another receiver at Whittlesey, a boy of 16, also obtained the hourly reports on a single valve set. Letters from Leeds and Birmingham congratulate the broadcasting station, but congratulation is also due to those who received, for good reception of telephony broadcasting depends largely upon the efficiency of the receiving set.

From Cheshire a letter was received from a man with a home-made set using a Mullard "Ora" valve. He says his aerial is about 80 ft. long and averages about 18 ft. high only. It has the usual two wires spaced 6 ft. The apparatus is mounted on an old box and ebonite is conspicuous by its absence. His grid condenser consists of two pennies with waxed paper between. He received the details of the race so clearly that to use his own words :—"If the speaker had been, say, one of my personal friends I feel sure I could have identified him by his voice."

An amateur at Hull reports that the 5 o'clock transmission was slightly interfered with by an arc station, and that repetitions were very useful for that reason. The set used in this case had one valve, and the aerial sloped from the roof of the house to a point 10 ft. above an out-house. The average height of aerial was 25 ft All of the other transmissions were received without trouble.

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A report from Brighton states that reception was made on one V.24 valve and a Reinartz tuner. The aerial in this case was 60 ft. long including lead-in, twin wire spaced only 2 ft. apart, the horizontal portion being 30 ft. above ground.

From Southsea, Hants, a letter was received from an amateur who used a single valve H.F. amplifier and crystal detector, aerial twin 50 ft. long 25 ft. high. He heard the transmitted progress of the race very clearly until he was badly jammed by a very loud spark station on 300 metres.

Another letter of interest states that the writer received the reports strongly and clearly at Leytonstone with a short indoor aerial. His crystal set is contained in a safety razor case measuring $1\frac{3}{4}$ ins. by $1\frac{3}{4}$ ins. by $\frac{1}{2}$ in., but the parts would comfortably fit in a case half that size. Two 42 S.W.G. enamel wire basket coils, $\frac{7}{8}$ in. in diameter are the tuning unit, and results are surprisingly effective.

*How the Air Race results were broadcasted from 2LO.*

Air racing has hitherto been difficult to follow. Machines started from the ground at given times according to their handicap, and they were soon out of range of the best field glasses. There was an air of expectancy tinged with a mixture of hope and doubt, but the race could not be watched. At certain points along the route observations were made, the competing aeroplanes were singled out, the time of their passing accurately noted and a few privileged persons heard on the telephone how things were progressing. The vast majority of people had no means of gaining intelligence of the race until the newspapers published the result, or the result of a part of the race.

On Friday and Saturday of last week the race for the King's Cup proved that any number of people could "watch," as it were, the race from start to finish.

At the Royal Aero Club a special receiving set was erected for the occasion

# Notes

**Cost of Wireless on Trawlers.**

A deputation from Hull is seeking the consideration of the Admiralty in respect of the requirement to install apparatus on trawlers. It is stated that the cost of upkeep will be £900 a year, and in view of the present state of affairs in the fish trade the question is serious.

**Reception of Air Race News at a Fete.**

A fête which was held in aid of the funds of the St. Pelagia's Home, was provided with a receiving set from which was obtained the broadcasted reports of the air race round Britain.

**Reduction in Price of Valves.**

It is gratifying to observe from the advertisement columns of this journal the very substantial reduction in the price of valves which is announced by manufacturers. One might have been justified in fearing that the increased demand for wireless apparatus would have resulted in an upward tendency in prices, so that the news is all the more welcome.

**Landlords and Wireless Aerials.**

From notes which have recently appeared in the daily press it is apparent that in some instances the attitude of landlords towards the erection of aerials on buildings will not be an encouraging one.

A reasonable attitude for a landlord to adopt would be to obtain an undertaking that any damage resulting from the erection of an aerial would be made good by the tenant. Beyond that it is difficult to see any reason for landlords to interfere.

For those unfortunate amateurs who may be domiciled in a building owned by the London County Council, it appears that the method of erecting the aerial and many other details must first receive the approval of the council, whilst amongst other formalities a deposit of £1 must be left with the council as security against damage.

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**Concerts by 2 LO on September 16th.**

Marconi House Broadcasting Station will transmit concerts on Saturday, September 16th, at 5–5.50 p.m., 6–6.30 p.m., and 7–7.30 p.m.

These transmissions will be for the Southgate Fête, in aid of the Royal Northern and Passmore Edwards Hospitals, and a fête in aid of the Croydon General Hospital.

**French Wireless Telegraphy Congress.**

A congress was opened a few days ago at Marseilles Colonial Exhibition to discuss matters relating to wireless telegraphy in France and her colonies, and the colonies among themselves.

**Norwegian Regulations for Foreign Vessels.**

According to the *Anglo-Norwegian Trade Journal*, the following regulations regarding the use of wireless stations on vessels belonging to foreign powers not at war, while in Norwegian territorial waters in times of peace, have been approved by Government resolution, and came into force on September 1st.

1. In Norwegian territorial waters wireless telegraph or telephone stations on foreign vessels may not be used, except by special permission, unless for the following purposes:—

(*a*) Communications concerning vessels in distress or for the prevention of accidents.

(*b*) Communications with the nearest Norwegian coastal station, and

(*c*) Communications with other ships' stations when each vessel is at least 10 nautical miles distant from the nearest Norwegian coastal station.

In the cases of (*a*) and (*b*) communication must at once be stopped on request from the Telegraph Administration, the Naval Department, or a station belonging to either of these authorities.

2. In Norwegian ports where there is a state wireless station and within certain prohibited districts laid down by the Norwegian authorities (regarding which information may be obtained from the nearest state coastal station), the ship's station may not be used except for communications as under 1 (*a*), unless special permission has been obtained.

3. Application for permission to use a station in Norwegian territorial waters for other communications than above-mentioned should be sent to the Telegraph Administration (Telegrafstyret), which will give its decision after consultation with the Naval Administration.

4. (This paragraph concerns war vessels).

5. When a ship's station is used while in Norwegian waters this must be done with dhe observance of the provisions of the International Telegraph Convention and its regulations.

6. The foregoing regulations remain in force only when Norwway is not at war, and are applicable only to vessels of nations not at war.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

Sir,—I beg to call your attention to a letter addressod to you and published in *The Wireless World and Radio Review*, of August 19th, from Mr. T. S. Skeet, of Leicester.

Mr. Skeet informs you that he heard **2PF** working to me on an indoor aerial. This is rather a wonderful feat, especially as I do not remember ever having the pleasure of working to **2PF.**

On referring to my log I find I was working to **2PS** of Nottingham on the date mentioned.

Evidently Mr. Skeet has made a mistake.

LEONARD M. BAKER
(operating **2FN**).

# Calendar of Current Events

**Saturday, September 16th.**

Concerts by **2 LO** on 6.30 metres at 5—5.30, 6—6.30, 7—7.30 p.m. See also Note on this page.

SOUTHWARK WIRELESS TELEPHONE ASSOCIATION. At King's Hall, London Road, S.E.1. Home-made crystal set competition.

**Sunday, September 17th.**

*Daily Mail* Concert from The Hague (**PCGG**), 8 to 9 p.m. B.S.T., on 1,085 metres

**Monday, September 18th**

IPSWICH AND DISTRICT WIRELESS SOCIETY
At 55, Fonnereau Road, Ipswich. Lecture by Mr. Stanley Lewis.

BOROUGH OF TYNEMOUTH Y.M.C.A. RADIO AND SCIENTIFIC SOCIETY.
7.30 p.m. Annual General Meeting.

**Tuesday, September 19th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2 MT** (Writtle).

**Wednesday, September 20th.**

NEWARK AND DISTRICT WIRELESS SOCIETY.
7.30 p.m. At Magnus Grammar School. First Meeting of Winter Session.

**Thursday, September 21st.**

*Daily Mail* Concert from The Hague (**PCGG**). 8 to 9 p.m. B.S.T., on 1,085 metres.

**Sunday, September 24th.**

*Daily Mail* Concert as above.

**Monday, September 25th.**

IPSWICH AND DISTRICT WIRELESS SOCIETY.
At 55, Fonnereau Road, Ipswich. Sale and exchange of apparatus.

**Tuesday, September 26th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2 MT** (Writtle).

**Wednesday, September 27th.**

REDHILL AND DISTRICT Y.M.C.A. WIRELESS SOCIETY.
At 111, Station Road, Redhill. Lecture on "Phones and Loud Speakers," by Mr. White.

**Thursday, September 28th.**

*Daily Mail* Concert, 8 to 9 p.m. (as above).

RADIO EXPERIMENTAL ASSOCIATION (NOTTINGHAM AND DISTRICT).
At Room 74, Mechanic's Institute. Discussion on Mr. Ford's lecture on "Radio Measurement." Subscriptions due.

**Friday, September 29th.**

WIRELESS SOCIETY OF HIGHGATE.
At Highgate Literary and Scientific Institute, South Grove, Highgate, N.6. Annual General Meeting, election of officers, annual report, etc.



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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### The Wireless Society of Highgate.*

Hon. Secretary, Mr. David H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

The Annual General Meeting of the Society will be held at the Highgate Literary and Scientific Institution on Friday, September 29th, 1922, at 7.45 p.m.

The agenda is as follows:—(1) Election of officers. All the Society's officers retire, and are eligible for re-election. The following officers do not wish to stand for re-election to their respective offices: Mr. D. H. Eade, Hon. Secretary; Mr. L. R. Rowlands, Hon. Treasurer; Mr. L. Grinstead, Vice-Chairman. It is further proposed that the Committee should be increased by the addition of two more members. Proposals for filling these vacancies and proposals for the Society's officers should be sent to the Hon. Sec. as soon as possible. (2) Annual report and statement of accounts. (3) New headquarters for the Society. (4) Future policy of the Society. (5) Any other business.

Members are requested to let the Secretary know whether they will be able to be present.

### The East London Radio Society.*

Hon. Secretary, Mr. L. E. Lubbock, King George's Hall, East India Dock Road, Poplar.

A meeting was held on Tuesday, August 29th, 1922, in the Society's Lecture Hall, in Woodstock Road.

Although the attendance was not so large as the previous week there was a fair number present. After the usual half-hour's buzzer practice the evening was devoted to open discussion for the benefit of the newer members. The Society's apparatus was laid on the table together with one of the member's crystal set, and a large number of matters were dealt with by the Society's expert and many members just starting were relieved of their difficulties. The meeting closed at 10 p.m. after a hearty vote of thanks to the chairman.

All interested amateurs in East London are invited to communicate with the Secretary.

### Radio Experimental Association (Nottingham and District).*

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A general meeting of the above Association was held on Thursday, August 31st, at the Mechanics Institute, Nottingham.

The lecture for the evening was entitled "Radio Measurements." Mr. Ford, the lecturer, exhibited expert skill and a convincing manner.

He had brought with him a considerable amount of apparatus used for calculating various measurements, and his explanations of the respective instruments were ably and clearly put before the audience. The lecturer illustrated the method of calculating unknown resistances by means of the Wheatstone bridge. The finish and construction of the lecturer's apparatus was deserving of special praise.

It was illustrated that manycalculations, seemingly difficult, can be accomplished quite successfully with fairly simple apparatus, care and accuracy only being necessary to ensure successful results.

Commencing October 12th, meetings will be held at the new headquarters.

The next meeting will be held on Thursday, September 28th, in Room 74, Mechanics Institute, when a discussion on Mr. Ford's lecture will take place. It should also be noted that subscriptions fall due on this date, after which the new winter session commences.

The Hon. Secretary will be pleased to meet at the meeting any amateurs in the district who are not members.

### Wakefield and District Wireless Society.*

Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Wakefield.

A meeting of the above was held at the Y.M.C.A., Grove Road, on Friday, September 1st, the chair being taken at 8 p.m. by Mr. Wrigley, who called upon Mr. Burbury jnr., to deliver his lecture on "The Two-valve High Frequency Amplifier," which is designed to obviate interference, to meet with future requirements of the P.M.G., viz., prohibition of interference.

Questions were asked, followed by a lengthy discussion regarding various circuits, and valve oscillation, thereby energising the aerial, which proved very interesting to all.

A hearty vote of thanks was accorded to Mr. Burbury, jnr.

### Borough of Tynemouth Y.M.C.A. Radio and Scientific Society.*

Hon. Secretary, Mr. G. J. S. Littlefield, 37, Borough Road, North Shields.

On Monday, September 18th, at 7.30 p.m., the Annual General Meeting of the above Society will be held in the Y.M.C.A. Buildings, Bedford Street, North Shields.

### Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The above Society opened its winter session on Wednesday, September 6th, 1922, at headquarters, the Y.M.C.A., Woolwich.

Two new features are being inaugurated, which should be of great assistance to beginners. A series of elementary lectures has been arranged on the construction and use of the fundamentals of a wireless set, *e.g.*, aerials, earths, inductances, condensers, crystals and valves, and will be given

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in a most simple way by one of the members, Mr. Houghton, from 8 to 8.30 p.m., each Wednesday evening. Also a buzzer class for beginners will be held from 7.30 to 8 p.m. on each evening. For the more advanced there is a six-valve set in operation, and much telephony and music are generally obtained. An attractive series of lectures and demonstrations is being arranged for the monthly meetings, which are held on the last Friday in each month.

Enquiries as to conditions of membership will be welcomed by the Hon. Secretary.

### Burton-on-Trent Wireless Club.*

Hon. Secretary, Mr. A. J. Selby, 66, Edward Street, Burton-on-Trent.

A most enjoyable and interesting afternoon was spent by the members on Saturday, August 26th, in a visit to the Burton electricity power station.

Mr. T. Hall, the borough electrical engineer, conducted the party and explained the whole working of the plant. The boilers were examined and the methods of coaling the fires were explained. The steam turbines and electricity generators were next visited and the working of them explained. The rotary converter, which converts the alternating current to direct current, to run the tram-cars, attracted much interest. Switchboards to the tram service were inspected.

At the instrument and testing shops it was seen how the electricity meters were tested and set accurately to a standard meter. Especially interesting was a new type of power switch designed by Mr. Hall, which is to be installed at all the large works where electricity is used. With this switch it is possible to change over in case of a breakdown of the electricity main to another main without having to send to the power station for a man from there to come and alter the connections to the mains. The switch is so constructed that there is no danger whatever in the operation of changing over to the new main.

Mr. Hall was bombarded with questions, which he very ably answered.

Mr. A. J. Selby proposed a very hearty vote of thanks to Mr. Hall, and Mr. L. G. A. Sims seconded. The vote was heartily endorsed.

Mr. Hall suitably replied.

### Otley and District Wireless Society.

Hon. Secretary, Mr. N. Weston, 24, Guycroft, Otley.

At the fifth meeting of the above Society, at Queen's Hall, Otley, on August 31st, further component parts of proposed five-valve amplifier were examined, the two air core H.F. transformers being voted very neat and efficient. A vote of thanks was unanimously passed to Mr. A. Gibson for his skill in winding. It will only be a matter of a week or two before the set is in operation. A further lecture was given by Mr. N. Weston, on induction, primary cells and H.F. oscillating waves. A series of valve set lectures will be delivered by Mr. H. Johnson at a later date. It is earnestly desired that members of similar societies who would give advanced lectures to the above Society would communicate with the Hon. Secretary. Thanks are rendered for the way the local paper has helped the publicity campaign for the above. A number of members have not quite got to the action stage. It is requested that they come forward at an early date. Lectures are given each Thursday at Queen's Hall until further notice.

### Barnoldswick Wireless and Technical Society.

Hon. Secretary, Mr. J. Balderston, 6, Clough Terrace, Barnoldswick.

A meeting of the above Society was held on August 30th, at the Gladstone Liberal Club. Preceded by the usual 30 minutes "buzzer" practice, a lecture was given by Mr. G. Balderston, entitled "Electro Magnetism." The lecture was delivered to a most appreciative audience. Another meeting took place on Wednesday, September 13th.

### Ipswich and District Wireless Society.

Hon. Secretary, Mr. F. T. G. Townsend, 46, Grove Lane, Ipswich.

An interesting excursion under the auspices of the above Society took place on August 26th, when, by kind permission of the Great Eastern Railway Co., a party of 20 members visited the Company's land station at Parkeston Quay. The party was met and escorted round the station in relays by Mr. Child, the resident engineer, and all appreciated his kindness, and also that of the operator in charge, who spared no effort to demonstrate his set. Tea was afterwards partaken of at Dovercourt and the return journey made by train *via* Manningtree, where a two hours' discussion took place—thanks to an engine breakdown.

The winter session is opening with a lecture by Mr. Stanley Lewis on September 18th.

There will be a sale and exchange of apparatus on Sept. 25th. Local non-members are invited on any Monday evening at 55, Fonnereau Rd., after Sept. 11th.

### Swinton and District Amateur Radio Society.

Secretary, Mr. Geo. T. Bultitude, "The Slade," Swinton, near Rotherham.

The inaugural meeting of the above Society was held on August 25th, when a good number of amateurs attended. The Secretary (*pro tem.*) explained that he had been pressed by interested wireless students to call the meeting. Mr. A. Hammerton presided. The meeting resolved to inaugurate a Radio Society.

The Hon. President and Vice-Presidents were nominated. The Committee elected were:—Messrs. Woods, Oxby, Finn, Henson, Greenfield, Twigg, Hammerton and Trowbridge. Mr. A. Hammerton was elected as Treasurer. Mr. Geo. T. Bultitude, Secretary and Librarian. The fixing of fees and subscriptions was adjourned for the Committee to decide at the meeting on September 4th. New members will be welcomed at the weekly meetings.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. W. Cutler, 24, Floating Bridge Road, Southampton.

A general meeting of the above Society was held on Wednesday, August 23rd, for the election of officers for the ensuing three months; all the old officers were re-elected. Elaborate plans are being made for the benefit of the members for the coming winter months and a competition is being held within the next few weeks. Dr. MacDougall has offered a substantial prize for the best single valve set made by any member of the Society. A committee is being appointed to make the



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necessary arrangements. Arrangements are also being made for a lecture every other week and followed the next week by a demonstration on various sets.

The membership is steadily increasing, a large percentage of new members coming in from the country districts. Any amateur in Southampton and district requiring particulars of the above Society can have same by applying to the Hon. Secretary.

### Redhill and District Wireless Society.

Hon. Secretary, Mr. J. S. B. Clarke, 41, Hatchlands Road, Redhill.

A meeting ot the Society was held on August 2nd, when an excellent lecture on aerial systems by Mr. Ross was read by Mr. W. Pope, M.I.R.E., Mr. Ross being unavoidably absent.

The paper gave practical methods of erecting aerials and will be of great value to the members. The half-yearly list of lectures which has just been issued includes the following items:—September 27th, "'Phones and Loud Speakers," Mr. White; October 11th, "Condensers," Mr. Edwards; October 25th, "Inductances," Mr. Pescett; November 8th, "Tuning"; November 22nd, "Operating," Mr. Ross; December 6th, "Gadgets," Mr. Clarke; December 20th, "Calculations"; January 3rd, 1923, "Direction Finding."

It is particularly requested that members will support the Society by attending these lectures, which will be found to benefit both the beginner and the more advanced amateur.

Questions can be placed in the "Question Box" in the wireless room any time during the week and will be answered by a competent member of the Society during the discussion following the lectures.

### Halifax Wireless Club and Radio Scientific Society.

Hon. Secretary, Mr. L. J. Wood, Clare Hall, Halifax.

The club-room is now open three nights a week with a steward in charge and members and others interested are turning up well.

The syllabus for the winter session is in course of arrangement and includes, apart from lectures for members, a "Popular Lecture," and a "Sale and Exchange, with Demonstrations."

All in the district who are interested, are advised by the Society to pay a visit to this latter event, and full details of the sale will be sent to anyone interested.

Membership steadily increases and associates are also coming in well.

### Fulham and Chelsea Amateur Radio and Social Society.

Secretary, Mr. R. S. V. Wood, 46, Hamble Street, Fulham, S.W.8.

A general meeting was held on August 30th at 8 p.m. at the Social Centre, Townmead Road, Fulham (headquarters for a period of three weeks, where a meeting is held each Wednesday at 8 p.m.).

The minutes of the previous meeting were read and accepted.

Mr. Hawthorne kindly took over the management of the Morse class, which was conducted satisfactorily. A discussion was invited from the remaining members as to the best or phenomenal results obtained on any aerial, insulating being especially dealt with by the Secretary.

Numerous interesting items were discussed and the Secretary gave his experience on one and two valves, and answered a number of questions. New members were proposed by Mr. Cox and seconded by Mr. Gauntlett, the meeting accepting their enrolment. Fourteen new members were enrolled. There was an attendance of 43. The total membership is now 57.

The meeting closed until the following Wednesday.

### Hornsey and District Wireless Society.

Hon. Secretary, H. Davy, 134, Inderwick Road, Hornsey, N.8.

A meeting of the above Society was held on Friday, September 1st, when many members brought up their sets, which were arranged on the table, and a photograph of the whole apparatus together with members was taken. Afterwards an informal demonstration was held by members on their respective sets and a good opportunity was afforded for comparing various methods of valve and crystal circuits, tuners, etc. The construction of each set showed considerable ingenuity, and the owners were heartily congratulated by all present.

Also a further programme was arranged to carry on from that arranged to September 11th, to consist of listening-in, lectures, Morse practice, etc.

It was hoped that the Club set, which was almost completed, would be in use by September 11th.

A hearty vote of thanks was given to Mr. Pugh for his lecture on Tuesday, August 29th, on the theory and practice of crystal sets. The meeting then closed.

Meetings are held every Tuesday and Friday and applications for membership are cordially invited.

### Southwark Wireless Telephony Association.

Hon. Secretary, Mr. W. Helps, King's Hall, London Road, S.E.1.

On Sunday, September 3rd, a meeting was held at Headquarters, King's Hall, London Road, S.E.1, when Mr. Winston ably answered questions. An instructive time was spent in this way.

It was announced by the Hon. Secretary that he was still open to receive entries for the "Home-made Crystal Set Competition," which was open to members of the Association, and also to members of kindred associations. The competition is to be held on Sunday, September 17th, and will be judged by Mr. Read. All enquiries should be directed to the Hon. Secretary at the above address.

The objects of this association are: "To assist members in furthering their knowledge of all methods appertaining to receiving of wireless telephony, by mutual interchange of views and lectures from time to time by wireless experts, also to help members by co-operation in buying their sets or spare parts."

Meetings are held every first and third Sunday of the month. Fees are as follows: 1s. to join, and 6d. per month, payable in advance.

### The Thanet Radio and Experimental Society.

The above Society is going well, and the membership is increasing weekly.

Meetings are held every Tuesday at 7 p.m., at 119, Northdown Road, Margate, and visitors will be welcomed.

President, Mr. G. W. May, 75a, Trinity Square. Press Secretary, Mr. F. McCardle, 4, Grange Villas, Margate.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

***In view of the serious interference which an oscillating receiver can cause to other receivers in its neighbourhood, it is understood that for broadcast wavelengths, certainly, and possibly for all wavelengths, the Postmaster-General will in future allow no type of circuit which is capable of oscillating and so energising the aerial, either directly or through any circuit coupled to it.***

***The necessary consequence of this restriction is that if reaction of the type commonly used in the past is still employed, it must be in such a way that the oscillation point cannot be reached over the wavelength range of the receiver, however tightly the reaction coil is coupled, and with whatever values of filament voltage or plate voltage the set is worked.***

***In order to comply with this requirement, it is essential that the reaction coil should be sufficiently loosely coupled to the aerial inductances as not to set up oscillations or alternatively the reaction might be arranged between the grid and plate circuits of a high frequency amplifier as shown on p. 715 of the issue of September 2nd.***

***We strongly urge readers who are making or using sets of the usual reacting type to either reduce the amount of reaction which they can employ to such an extent that they are perfectly satisfied that the set can never oscillate or to cut out their reaction entirely.***

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**"TEC" (Ealing)** *asks (1) The cause of a continuous note heard in the telephones. (2) Why he obtains no results, and if the connections are right. (3) If Sullivan's telephones marked "A" are* 8,000 *ohms. (4) To what wavelength would a certain tuning coil tune.*

(1) Probably an induction from A.C. lighting or power supply in the vicinity. (2) Your connections are fairly good, and you should get some results. You ought to get broadcasting, although your coil is rather large for the purpose. (3) We believe 6,000 ohms. (4) Maximum about 3,000 metres, minimum difficult to say. Probably inefficient below 600 metres.

**"B.P." (Bombay)** *asks (1) What is the natural wavelength of a certain loose coupler. (2) and (3) Questions relating to pile-wound inductances.*

(1) Loose couplers do not have natural wavelengths in any useful or predictable sense, but your loose coupler would be suitable for tuning to about 4,000 metres with the larger coil in the aerial circuit. (2) You will find pile winding of wires of these gauges a terribly tedious and unsatisfactory operation, and we should strongly recommend the use of honeycomb coils for the purpose. (3) Neither of the suggested schemes give pile winding at all. For guidance, see article in the issue for October 2nd, 1920, obtainable from the publishers.

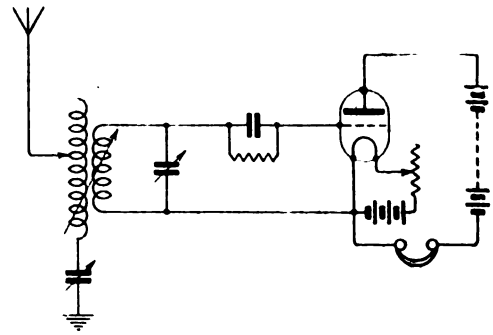

*Fig. 1.*

**"P.T." (Maldon)** *asks for a diagram of a certain receiving unit. (2) How to calculate the capacity of condensers.*

(1) See diagram (Fig. 1). (2) See reply to **"Radio 3 UC"** in the August 5th issue.

**"C.M." (Oldham)** *asks (1) Which of four tuning systems is the best. (2) If a certain coil would receive telephony. (3) For advice with regard to his aerial. (4) If a microphone button would be suitable for a loud speaker.*

(1) It is almost immaterial which of the last three. The slab coils would be less efficient. (2) Your coils are too big to give satisfaction on short wavelengths, for which you would probably only want about 20 turns with these diameters. (3) Nearness to the roof explains poor signals, also possibly your earth is less efficient. Raise your wires as suggested. (4) The suggested arrangement would not be of any use. Use the H.R. earpiece.

**"J.E.M." (Rotherham)** *has a single valve panel and (1) Wishes to convert it to a four-valve set. (2) Whether a three-valve receiver will be suitable for reception of* **FL, 2MT,** *and* **PCGG** *on his aerial*

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*in an open position.* (3) *What values the tuning condensers should have.* (4) *Whether he should make use of reaction.*

(1) See diagram Fig. 2. (2) Yes. (3) For short wave work the aerial tuning condenser need not have a larger value than 0·0005 mfds., but for long wave work a value up to 0·002 mfds. may be found convenient. For tuning direction coil or closed circuit, a suitable value is 0·0005 mfds. (4) The use of reaction is recommended, as shown in the circuit diagram.

**"W.T.O." (Cheshire)** *encloses a diagram of his single valve receiver and asks if it is O.K.* (2) *What maximum wavelength can he obtain with a certain A.T.I.* (3) *If a certain A.T.I. is suitable for connecting to a five-valve amplifier for receiving broadcasting.*

(1) Yes, but it would be better to connect the two sliding inductances as in the Fig. (*N.B.*—Reaction of type suggested is not now allowed.) (2) 4,000 metres. (3) Yes, fairly efficient for the purpose.

**"SUBSCRIBER" (Birmingham)** *asks if enamelled or ordinary 7/22 is the most efficient for the aerial, and rubber covered for the earth wire.*

There is little to choose between plain and enamelled for the aerial, although the latter is slightly preferable. Any of the three may be used for the earth wire but rubber covered is best.

**"A.G.W." (Camden Town)** *asks* (1) *For winding data for certain coils.* (2) *For criticism of a diagram of a three-valve note magnifier.*

(1) Reaction of the type indicated is no longer to be permitted. The A.T.I. might be 6″ × 3″ of No. 24. The L.F. transformer, core ¼″ diameter of iron wire, windings 1 oz. and 3 ozs. of No. 44 S.S.C. (2) We have no criticism except that the set is not a three-valve note magnifier.

**"NOVICE" (Newhaven)** *asks* (1) *If the circuit shown on page 554 of July 29th issue is suitable for reception with honeycomb coils and a single wire 100′ aerial.* (2) *If a tapped H.F. transformer is necessary.*

(1) Yes, but reaction of the type indicated is no longer permitted by the P.M.G. (2) If a considerable range of wavelengths is required a tapped H.F. transformer is very desirable.

**"INDUCTANCE" (Salford)** *asks for certain information about a set described in "Practical Amateur Wireless Stations."*

Statements of this nature are calculated to deceive. You might possibly get a range of 8,000 metres with a 500 k.W. station at the transmitting end, but 7,000 miles would be unlikely even under these conditions. Your broadcast range might be 100 miles, but for this purpose we should prefer a set of smaller coils than the type you suggest.

**"S.M.P." (Wellingborough)** *asks* (1) *If it will be better to buy parts of a receiving set in France where he is going for his holiday, or to buy them in England.* (2) *If a receiving licence is necessary in France, and may an English licence be used on the Continent.* (3) *If the condenser should be put across the H.R. telephones alone, or across telephones and H.T. battery.* (4) *If the A.T.C. should be on the earth side of the A.T.I.*

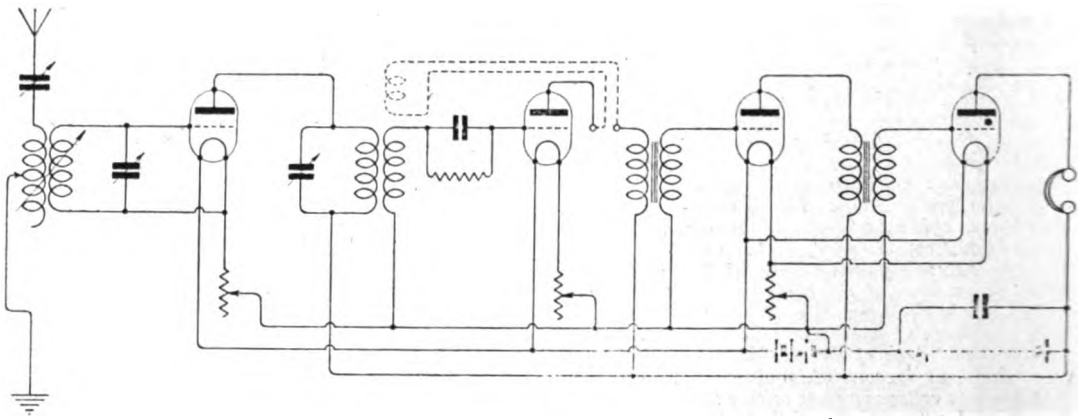

*Fig.* 2.

(1) It depends on how long you are going to be there. If you purchase in France you will have to pay a heavy duty on returning, and may even find yourself prohibited from bringing the goods into this country. If you are just going for a holiday we should advise you to do without the pleasures of wireless, unless you are prepared to incur considerable expense. (2) Apply to the Department of Posts and Telegraphs. No. (3) Put it across both telephones and battery. (4) In most valve circuits the A.T.C. should preferably be on the aerial side of the A.T.I.

**"W.G.P." (Barnes)** *asks certain questions regarding the super-regenerative circuit*

(1) The values of the condensers suggested will be satisfactory. (2) The value of inductances for the tuning circuit should be the same as normally used for short wave work. For the oscillating circuits values should be suitable for about 5,000 metres. (3) For the grid battery flashlamp dry cells will be sufficient, the exact voltage required in each particular case being determined by experiment. The value will probably not exceed 12 volts.

**"J.S.F." (Herne Hill)** *asks* (1) *For circuit diagram of a telephony transmitting set suitable for working on wavelength from 400 to 450m. and using 10 watts.* (2) *Whether the diagram given will eliminate the transmission of carrier wave when no speech*

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*is taking place.* (3) *Whether A.C. supplied at 50 frequency is suitable when stepped up and rectified as a source of H.T. and* (4) *Types of valves suitable for* (*a*) *low power transmission, and* (*b*) *rectification for H.T.*

(1) and (2) The most suitable telephony transmitting circuit is that embodying "choke control" and a suitable circuit is given in Fig. 3, making use of step-up transformer and rectifying valves for providing plate current. The system of quiescent modulation is not always to be recommended, and usually functions by some arrangement of grid potential control. (3) Yes: this can be done, but necessitates the use of high tension condensers of very large capacity for the purpose of smoothing out the ripple. A rectified plate current of about 1,000 to 1,400 volts should be aimed at in designing the transformer. (4) (*a*) T.15 to T.50. (*b*) U1.

(1) An increase in length somewhat increases signal strength, but not so much as a corresponding increase in height, moreover the P.M.G. does not allow more than 100′ length to be used. (2) You might have some difficulty, and will probably need at least four valves, now that variable reaction on to the tuning circuits is not to be permitted. Interference from Carnarvon is not likely to be very serious unless this station should at any time revert to the use of arcs, which is unlikely. (3) "The Construction of Amateur Valve Stations," by Douglas. (Wireless Press, Ltd.).

**"A.B." (Stoke-on-Trent)** *asks, among various other questions* (1) *The formula to calculate the capacity of an air condenser.* (2) *How to calculate the capacity of a cylindrical coil.* (3) *The wavelength a certain coil and condenser would tune to.* (4) *What happens when a long earth lead is used.*

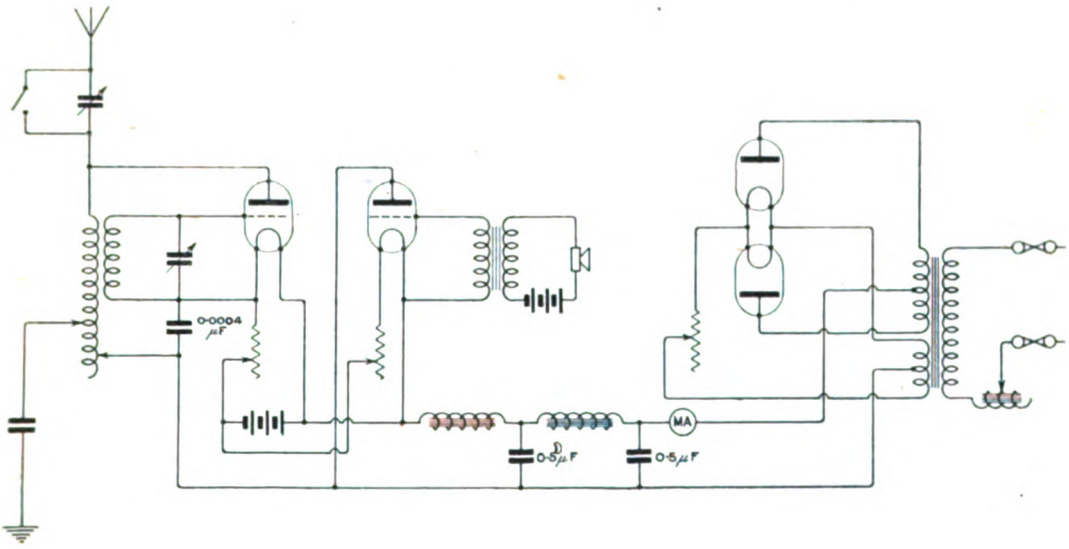


*Fig.* 3.

**"A.M.W." (Hammersmith)** *asks for a working description of the Mk. III Tuner.*

We have not space to give a full working description, but the instrument is a short wave tuner working up to about 700 metres. It contains two tuned circuits with tuned stroke stand-bi switch. Tuning is effected by stud switches to inductances and variable condensers. Two crystals, carborundum with a battery and galena without, are fitted, as well as terminals for a detecting valve. The instrument, while of excellent design for its purpose, is unnecessarily elaborate for amateur construction. We should recommend you to purchase one of the Disposal Board instruments, now offered by various dealers, or at any rate to examine one of these instruments before deciding to make one.

**"D.S." (Anglesea)** *asks* (1) *The effect of increasing the length of an aerial.* (2) *If the three proposed broadcasting stations within 100 miles range could be heard among the mountains within 7 miles of Carnarvon.* (3) *For a fairly simple book dealing with the construction of a two to four-valve set.*

(1) See reply to **"Radio 3 UC"** in the August 5th issue. (2) Cylindrical coils do not have a capacity in any useful sense. The formula for their inductance has been repeatedly given. (3) About 800 metres. (4) Strength of signals is considerably reduced. From the remaining questions we should recommend you to study Bangay's "Elementary Principles."

**"F.A." (Birmingham).**—(1) Correct. (2) We should prefer 6 ozs. of No. 32 for the L.R. winding, but ¼ lb. of No. 36 will probably give fair results. (3) Doubtful, or very unlikely now that reaction from the oscillating point is not permitted.

**"F.W.P." (Nottingham).**—We are unable to answer your questions from the information supplied. If you will forward a diagram of your circuit we shall be pleased to advise you. It is quite possible to add either H.F. or L.F. amplification to the original tuner, or even both.

**"J.C.D." (Much Wenlock)** *sends a sketch of two panels, and asks* (1) *How to connect them to the batteries and condenser.* (2) *For criticism of his set.*

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(1) Connect up as in diagram (Fig. 4). (2) As far as we can judge from the very rough sketches submitted this arrangement should be fairly satisfactory. Also move telephone connections on second panel to the positive side of the H.T. battery terminals.

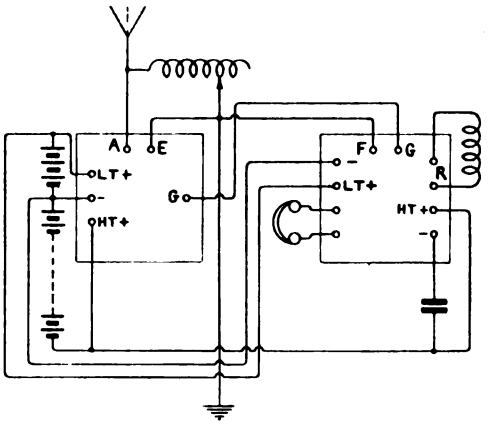


*Fig. 4.*

**"S.H.S." (Liverpool).**—(1) About 0·001 mfd. would be satisfactory, but reaction of this type is not permitted according to the regulations of the P.M.G. (2) Circuit shown is quite satisfactory. A potentiometer to the first grid would be an improvement. (3) We do not recommend "Lokap" wound coils for broadcasting wavelengths, as so few turns are required. With a diameter of 1", about 100 turns would be quite sufficient. You might make coils to the design shown on page 328, June 10th issue. (4) We are unable to give dimensions for suitable reaction coils as the P.M.G. will not allow reaction which is capable of energising the aerial. The amount which could be used without doing this varies so much with conditions—such as the type of aerial, characteristics of the valves, etc.—that it is impossible to predict a safe value.

**"H.H." (Wimbledon)** *asks* (1) *For the most efficient single valve and crystal circuit for telephony.* (2) *How to adapt a circuit shown for this purpose.* (3) *A question with regard to his aerial.*

(1) and (2) For diagram see Fig. 3, page 537, July 22nd issue. (3) If your house is at the high end of your aerial the addition of a mast on the roof will considerably improve signals. If, however, your house is at the low end the improvement will hardly be worth while.

**"V.P.S." (Norbiton)** *asks* (1) *For a diagram of a set to fulfil certain requirements.* (2) *If L.R. telephones could be converted into a loud speaker by fitting a horn.* (3) *If he could get* **PCGG, 2 MT, 2 LO** *and Croydon Air Station at Chatham with receiver of question* (1).

(1) The circuit of Fig. 5, page 573, July 29th issue, is a good one, particularly as it uses reaction in a way which is not prohibited by the new restrictions, provided that there is no coupling between the circuits of the second valve and the A.T.I. (2) This may be done if desired but the results will not be very good, as the quality will be somewhat poor and the strength not very great. (3) All these stations should be possible with the exception of PCGG, which is very doubtful. (3) The values suggested will be quite satisfactory for a Vernier condenser.

**"R.H.W." (Coventry)** *submits a circuit and asks* (1) *For criticism.* (2) *Whether it will receive* 800/5,000 *metres.* (3) *Values for plate resistance.* (4) *Best position and resistance of telephones.*

(1) and (4) Circuit is O.K. except that the A.T.I. is much too small. It should be about 10,000 mhys. instead of 250 and no resistance is needed in the plate of the last valve. The telephones should be introduced in place of this resistance. (2) Yes, with the alteration to the A.T.I. suggested above. (3) About 50,000 ohms.

**"A.L.D." (Manchester).**—(1) A grid condenser and leak is not necessary, but it may be used if desired (a leak without a condenser is perfectly useless). If employed, it should be connected directly in the lead to the grid in the diagram on page 781. (2) FL probably; 2 MT very unlikely. (3) This set was never intended for short wave reception and it is impossible to make it efficient on such wavelengths while retaining the large coils suitable for long range reception. See note at head of these columns regarding reaction. The windings given in the article referred to will no longer be permitted.

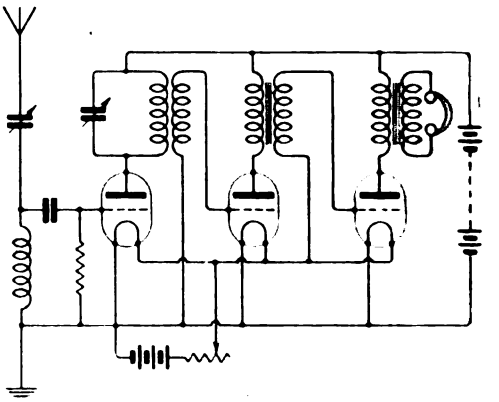

*Fig. 5.*

**"CONCERT" (Woolwich)** *asks* (1) *If an amplifier, of which diagram is enclosed, will be suitable as regards lay-out and spacing of instruments.* (2) *Details for wiring up amplifier.* (3) *If the set will be suitable for receiving amateurs and Dutch concerts.* (4) *If a Sullivan L.F. transformer instead of the army type would give better results.*

(1) Yes. (2) The circuit should be wired up as in diagram (Fig. 5). (3) Certainly. (4) Possibly a little better, but not likely to be much different.

**"NEGATRON" (Coventry)** *asks* (1) *For criticism of a set sketched.* (2) *For the cause of noises in his set.* (3) *How many plates to use in a condenser for tuning H.F. transformers.* (4) *Windings for certain H.F. transformers.*

(1) Circuit sketched appears quite satisfactory, but reaction in the form suggested is capable of

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making the aerial oscillate and is therefore not allowed under the present P.O. restrictions. (2) From the information given we cannot state the causes of these noises, which may, however, be due to defective batteries. You should try and find out the cause by test. For instance, if you change the batteries and still get the noises, the cause is not the batteries—and so on with each other possible cause. (3) About 12 fixed plates will be desirable. (4) 300/500 metres—about 50 turns for each winding; 1,000 metres—100 turns; 2,000/3,000 metres—200 turns. These would be probable values, but they should be checked by experiment.

**"I.S.D." (Chiswick)** *asks re circuit on page* 504 (1) *If basket coils could be used for the oscillation tube.* (2) *Values for the batteries and condenser across grid inductance of oscillator.*

(1) Basket coils could certainly be used. (2) H.T. batteries normal. The grid batteries determine by experiment up to about 10 volts. Condenser about 0·001 mfd. (3) Yes. This circuit may give serious reradiation if incorrectly adjusted and would therefore not be permitted by the P.M.G.

**"S.W.R." (London)** *asks three questions about a variable grid leak.* (4) *For particulars of the nearest broadcasting station to Rugby.*

(1) (2) and (3) We do not know of any satisfactory leak of this nature on the market. Results could probably be obtained with either a graphite line resistance, with variable contact strips to alter the length of the line in circuit, or a liquid resistance, using some organic liquid of high resistance with movable electrodes. We do not think that the results would justify the trouble involved. (4) Birmingham, using 1½ k.W. The station has not yet started operations, and its exact wavelength is not fixed, although it will lie between 350 and 425 metres.

**"G.H." (Goteborg)** *asks* (1) *For criticism of a diagram of set.* (2) *For winding for an A.T.I. up to 4,000 metres.* (3) *What coils to use for 15,000 metres.* (4) *Whether an indoor aerial will give results.*

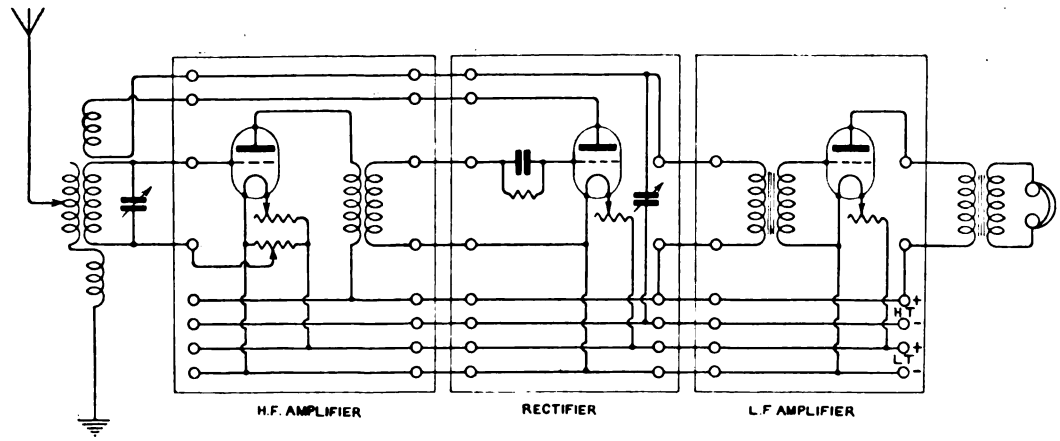


*Fig. 6.*

**"R.A.Y." (Glasgow)** *asks questions about a three-valve set.*

(1) See Fig. 1, page 435, issue for July 1st, but note that reaction as shown in this diagram is no longer to be allowed. (2) Three coil holders will be required for a reaction set, but reaction of this sort, capable of energising the aerial, is no longer to be allowed, and a two coil holder will therefore be all that you require. (3) See diagram (Fig. 6).

**"R.A.H." (Hull)** *asks* (1) *For formula for calculating the capacity of condensers.* (2) *If "Ora" and "R" valves are interchangeable.* (3) *Windings for certain H.F. transformers.* (4) *If enclosing each panel in an iron box is advantageous.*

(1) See reply to **"Radio 3 UC"** in the August 5th issue. (2) The "Ora" valve will work satisfactorily with less plate voltage than the "R" type, otherwise the characteristics are very similar. (3) Use formers 1½" diameter by 4" long. For the various ranges the turns for each winding may be as follows, but considerable experimental adjustment might be needed, and in particular we doubt if you will get the whole of the last range with a single transformer unless about No. 48 resistance wire is used. (1) 30 turns; (2) 60 turns; (3) 120 turns; (4) 500 turns. (4) This might be advantageous from the point of view of keeping down unwanted interaction in the circuits. If used the boxes should not be too small.

(1) Set is O.K. except for the 0·004 mfd. condenser between plate and earth on the first valve, which is very undesirable. A leak should also be introduced between grid and filament of the second valve. (2) 10" × 8" of No. 24. (3) Use honeycomb coils, the makers of which generally quote wavelength for each coil with a stated condenser. With your aerial you will probably require a size larger for the A.T.I. than is needed for the closed circuit. (4) The indoor aerial will give you some results if it is as high as possible above your set. In any case it should give a spark station 5 miles away.

**"M.T.G." (Manchester)** *asks* (1) *For a diagram of a two-valve receiver with L.R. telephones and a transformer and L.F. intervalve transformer, and if possible a loud speaker.* (2) *If the coils X and Y in a diagram on page* 217 *of May 15th issue*

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*bear any relation to each other.* (3) *If it will be possible to put* 10 *coils and a ten-way switch in place of the coil Y in the sketch.* (4) *The capacity of the variable condenser C and the fixed condenser C.*1.

(1) If you want to use a loud speaker on near-by stations, we should recommend L.F. amplification. If, however, you want the maximum possible range we should prefer H.F. For a suitable circuit with L.F. amplification, see diagram (Fig. 7). (2) These coils should be coupled together, but there is no definite relationship between their sizes. The size of Y is determined by the wavelength required, X is then made of size large enough to give sufficient reaction with Y. (3) Yes, but not very efficient. (4) C = 0·0005 mfds., and C.1 = 0·0002 mfds.

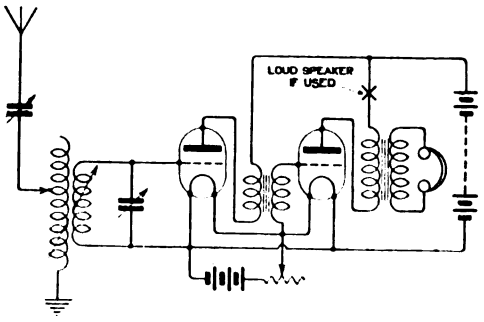


*Fig.* 7.

"**C.W.B.**" **(St. Leonards)** *refers to the super-regenerative circuit on page* 305 *and asks* (1) *Maximum capacity of the three variable condensers.* (2) *If one four-volt battery could be used to supply the three-valve filaments.* (3) *Correct sizes for the coils.*

(1) Tuning circuit condenser 0·0005 mfds.; oscillator condensers about 0·002 mfds. (2) Probably, but the circuit might be more difficult to adjust. (3) Coils for tuning circuits should have normal values for short wave reception. L4 and L5 should have values suitable for about 5,000/30,000 metres.

"**A.V.S.**" **(Hull)** *asks* (1) *For diagram of three-valve set to fulfil certain requirements.* (2) *How many plates* 1½" *diameter would be required to build up a* 0·001 *mfd. condenser, with* 1/16" *between moving and fixed plates.* (3) *If two* 0·005 *mfd. condensers connected in parallel would be equivalent to one* 0·001 *mfd. condenser.*

(1) See diagram on page 435, Fig. 1, July 1st issue, omitting reaction coil there shown, which is no longer allowed by the P.M.G. (2) With plates of this size almost 200 would be required. (3) Yes.

"**T.R.**" **(Barnsley)** *has a two-valve set which is giving trouble and asks* (1) *For advice.* (2) *If certain alterations to the connections would be satisfactory.* (3) *If a variable condenser in parallel with the plate and grid is an advantage.* (4) *If a* 0·001 *mfd. variable condenser is too large for tuning* 440 *metres telephony.*

(1) and (3) The use of a condenser in the way you suggest is quite enough to explain the persistence of oscillations. It is very difficult to criticise your set in other respects as your diagram shows nothing of the internal connections (2) Suggested method is useless. Condenser and leak, if used, should be introduced between *A* and the grid of the first valve. (4) This is too high a value unless it is used in series with the A.T.I. This is much preferable to a parallel arrangement on such wavelengths.

"**D.G.W.**" **(Jersey)** *submits a circuit and asks if it is a super-regenerative one.* (2) *Values for certain coils.* (3) *If certain stations could be heard in Jersey with a three-valve set.* (4) *In what issue of "The Wireless World and Radio Review" tables of Nagaokas correction factor K in the formula for calculating the inductance of single layer coils were given.*

(1) The circuit shown bears some family resemblance to Armstrong's super-regenerative circuit, but we are unable to say whether it would function as it stands. L.1, L.2 and V in your circuit should have values suitable for tuning a single circuit receiver to 5,000/6,000 metres. (3) With luck all these stations might be received. (4) As this formula has not been recently given, we repeat it here with the tables asked for:—

$$L \text{ mhys} = \pi^2 d^2 n^2 l \times K.$$

Where $d$ is the diameter of coil in cms. $n$ = number of turns per cm.

$l$ = length in cms., and $K$ the correction factor, which varies according to $d/l$.

We quote a number of values from which a curve may be drawn, by means of which $K$ may be found for any value of $d/l$.

| $d/l$. | $K$. | $d/l$. | $K$. |
|---|---|---|---|
| 0·1 | = 0·96 | 1·5 | = 0·59 |
| 0·2 | = 0·92 | 2·0 | = 0·53 |
| 0·4 | = 0·85 | 2·5 | = 0·47 |
| 0·6 | = 0·79 | 3·0 | = 0·43 |
| 0·8 | = 0·74 | 4·0 | = 0·37 |
| 1·0 | = 0·69 | 5·0 | = 0·32 |
| 1·25 | = 0·64 | 7·0 | = 0·26 |
| | | 10·0 | = 0·20 |

"**F.C.K.**" **(South Norwood).**—(1) The first circuit shown is the better of the two, and not at all bad, but it has no advantages of the normal type illustrated, for instance, in Fig. 6, page 437, July 1st issue. (2) If the normal type referred to is used, the A.T.I. for 3,000 metres may be 9" × 6" of No. 22. A somewhat larger coil would be required for this wavelength with the arrangement you suggest.

"**J.F.**" **(Harlesden)** *sends a diagram of a valve and crystal set and asks* (1) *For criticism.* (2) *What results would be obtained on a rather poor aerial.* (3) *If polished mahogany, or other hard wood could be used for a base-board.* (4) *Dimensions of the coils to tune to* 3,000 *metres.*

(1) O.K., but it would be much better to introduce a 0·005 mfd., variable condenser across B. (2) You should get London broadcasting, amateurs in the London district, ship sets, Croydon, Eiffel Tower, etc. (3) Hard wood may be used as a base, but if so it is preferable to use rubber insulated wire for connecting up through the base-board. (4) Coil A, 9" × 7" of No. 22; coil B, 7" × 5" of No. 24. According to the new Post Office regulations these two coils must not be coupled together.

"**NEW READER**" **(Kirton Lindsey)** *asks* (1) *For criticism of an amplifier diagram.* (2) *For sketch of a tuning circuit and detector valve to use with it.* (3) *If we can recommend a more suitable circuit.*

(1) Quite O.K. (2) Suggested type is quite feasible but you would get somewhat better results

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from any of the three or four valve circuits, employing H.F. amplification, particulars of which have appeared in these columns recently.

**"AMATEUR" (Little Sutton).**—(1) Capacity 0·0013 mfds. (2) Gauge is No. 43, and might be used for either L.F. or H.F. transformers. (3) 8″ × 6″ of No. 22, with a tuning coil. We are unable to specify a suitable reaction coil. See note at the head of these columns. The only telephony you are likely to pick up at present would be local amateurs at irregular hours.

**"T.W.O." (Preston)** *asks* (1) *If 60 ohm telephones would be satisfactory with a suitable transformer.* (2) *Constructional details for a suitable transformer.* (3) *If the above telephones will be less efficient than 120 ohm telephones.*

(1) Yes. (2) Core ½″ × 3″ of iron wires. H.R. winding, 3 ozs. of No. 44; L.R. winding, 4 ozs. of No. 32. (3) Probably not so efficient as the 120 ohm telephones.

**"G.W.R." (Southwark)** *asks type, size and number of Leclanche cells which will be most suitable for a multi-valve amplifier with "Ora" valves.*

We much prefer dry cells owing to the tendency of the small wet Leclanche cells to "creep," giving messy and unsatisfactory working. You will require about 28 cells, and if wet batteries are used they might be about ¼ to ½ pint size.

**"X.Y." (London)** *has old-fashioned pull-wire bells in his house and asks if it would be possible to use these bell wires for an indoor aerial the house being four-stories high and bells running from top to bottom.*

These might quite conceivably give useful results in London from London broadcasting, but you would not be likely to get much else, and you might get noises and other troubles from bad connections in your wires.

**"NOVICE" (Bristol).**—(1) It would be better to take your down lead from the point X. (2) You should receive **FL** and the broadcasting stations at Plymouth, Cardiff, Birmingham and probably London, well enough for the purpose you require, but broadcasting stations at greater distances and **PCGG** would hardly give sufficiently good results. (3) You should expect the current change you suggest from many stations, which would be enough for recording purposes. The cost of a suitable relay would be about £15, and an inker about £10 to £25, if suitable for ordinary hand speeds, and up to £100 to £120 for high speed Wheatstone recorders or undulators. (4) Further L.F. amplification with a second rectification after it will be advantageous for recording purposes.

**"E.A.A." (West Ham)** *asks* (1) *For criticism of a set sketched.* (2) *Wavelength range to be expected.* (3) *If a different make of valve to that at present employed would be an improvement.* (4) *If he will lose signal strength by taking tappings with No. 30 from the coils wound with No. 22.*

(1) The arrangement submitted is quite suitable for a simple set, but the A.T.C. should be used in series with the A.T.I. for short waves. (2) You do not give us enough information to say exactly, but the range is probably from a few hundred metres up to at least 3,000. (3) This will give very little difference. (4) Not seriously, if the tapping leads are short and carefully sweated to the original wire.

**"E.C." (Southend)** *asks* (1) *What wavelength his set will tune to.* (2) *If the A.T.I. and condenser are O.K.* (3) *How to increase his wavelength to 3,000 metres.* (4) *Who is 2 MC and what is his wavelength.*

(1) As you do not say the size of the condenser plates or their spacing we cannot give the information required, but if this condenser is about 0·0005 mfds. the range is probably up to about 600 metres with series A.T.C., and perhaps 1,500 metres with parallel A.T.C. (2) O.K., if the plates of the condenser are 3″ to 4″ in diameter, and spacing between fixed and moving plates not more than 1 mm. (3) Add a loading coil—for instance, a honeycomb coil with about 300 turns, in series with the A.T.I. (4) This station is located at Westcliffe-on-Sea. [See note regarding reaction at the head of these columns.]

**"R.B.L." (Guildford)** *asks* (1) *For criticism of a set.* (2) *How to most easily turn a single valve set into a two-valve set, without the use of an inter-valve transformer.* (3) *If H.F. coupling is best and easiest, what coils he will require.*

(1) Set is of quite efficient type, but will not be allowed under the new restrictions of the P.M.G. See note at the head of these columns regarding reaction. (2) The best way of adding an extra valve is as in Fig. 5, page 573, July 29th issue. (3) This circuit, although it uses H.F. coupling, does not need inter-valve transformers. The easiest way of getting a big range would be by using honeycomb coils of assorted sizes for the coils on the anode side of the first valve.

**"J.L." (Paris).**—Grid condenser for this set may be about 0·0002 mfds., and telephone blocking condenser may be about 0·001.

**"R.J.R." (Westcliff-on-Sea)** *has a three-valve receiving set and asks how he can connect up to receive short waves.*

In order to get shorter wavelengths with this set, put the A.T.C. in series with the A.T.I. instead of in parallel with it.

**"E.A.A." (Angle).**—It is impossible, owing to the new restrictions on the use of reaction in a circuit of this nature, for us to give values. If any reaction is used it must be so little that the set cannot possible oscillate. The safe amount must be determined by experiment, and effective precautions taken to see that it cannot be exceeded. See note on this subject at the head of our columns.

**"W.H." (New Barnet)** *wishes to make a two-valve set and asks for a suitable circuit.*

In view of the new Post Office restrictions the circuit of Fig. 5, page 513, issue for July 29th, will be about the best that you can do. Care should be taken to see that there is no coupling between the three coils on the anode side of the first valve and the A.T.I.

**"R.J.S.C." (Sittingbourne)** *encloses diagram a set which will not work satisfactorily and asks of* (1) *If the wiring is O.K.* (2) *How to remedy buzzing noises in the telephones.* (3) *If he can hear Writtle, Paris, London and The Hague with this set.*

(1) Your diagram is not at all clear, but it appears to show the aerial and earth connected to the reaction coil instead of the A.T.I. This would be sufficient to explain poor results obtained. (2) Noise is apparently due to oscillation from the use of too much reaction. A set which can oscillate



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in this way is now definitely prohibited by the P.M.G. See note at the head of these columns. (3) Writtle, London and Paris—yes. The Hague very doubtful.

**"M.P." (South Africa).**—(1) This coil will tune the aerial to about 3,500 ms. (2) We should recommend the use of honeycomb coils for this purpose, but failing this, a coil, 12" × 9", wound with No. 28, would give the desired result if used with a parallel capacity. The closed circuit coil could be 12" × 8" of No. 32. (3) and (4) The best arrangement of apparatus would be as in the diagram (Fig. 8).

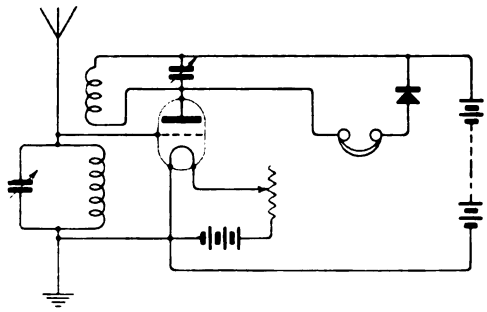

*Fig.* 8.

**"D.H.C." (Wallington)** *encloses a diagram of his set and asks* (1) *Why it will not work.* (2) *If there is a simple way of telling whether the valves are defective.* (3) *Gives details of an H.F. transformer and asks the approximate wavelength.*

(1) Circuit shown is quite correct. Failure to work is probably either because your set is not actually wired to the diagram, or some part of your apparatus is defective. See note at the head of these coulmns re reaction sets of this type. (2) The easiest way is to fit them to some tried circuit and see if they give results. The only common faults are grid touching filament, or plate touching grid. These can generally be seen by careful inspection, or in the first plate if the grid lead is shorted a change in filament brightness may occur when the grid is opened or closed. (3) Your circuit does not show a transformer of this type. This transformer would probably be suitable for about 5,000 ohms.

**"W.G.M." (Bristol)** *describes a set which will only receive in an oscillating condition and asks* (1) *How to stop the howl.* (2) *Maximum and minimum wavelength.* (3) *If wavelength can be increased by adding a loading coil in the aerial circuit.* (4) *How large a loading coil to add for certain specified wavelengths.*

(1) An oscillating set of this type is forbidden under the new Post Office regulations. Howling may be due to grid and plate leads being run too close together. The chief reason for loss of signals when reaction is removed, is the inefficiency of your aerial and also the fact that a 0·001 mfd. parallel condenser is grossly excessive for short wave reception. It is undesirable to use a parallel condenser at all. (2) Minimum approximately 300 metres; maximum about 1,100 metres. (3) Yes. (4) We cannot give the exact amount for each wavelength, but supposing the 0·001 mfd. condenser is removed, a loading coil 6" × 4" of No. 24 should be ample to go to 1,200 metres. The grid and filament of the valve should be tapped across both coils and not only the coil at present in existence.

**"M.A.C." (Glossop)** *asks* (1) *Where to find a description and circuits of the Marconi four-electrode valve.* (2) *For information on the self-capacity of coils.* (3) *Which is correct, Bangay's assertion on pages* 142-3 *of his book, that the L.F. valve should be worked well up the slope of the curve, or Penrose's that one of the bends should be used.* (4) *Which cartographic system should be used for D.F. calibration.*

(1) See page 198, May 13th issue, and page 230, May 20th issue. (2) Self-capacity is reduced to a minimum when each turn is separated as far as possible from the consecutive turn on the winding, and the winding is so designed that no two turns, which are numerically well separated, are geometrically in proximity. You will observe that these conditions are fairly well fulfilled by solenoid coils, and even better still by basket coils. (3) The valve should be worked well up the characteristic in the middle of the straight portion. In all other positions considerable distortion is introduced. (4) For this purpose gnomonic projection should be used. Neither Mercator's nor the ordinary atlas give true bearings.

**"R.B." (Carlisle).**—The set sketched should be satisfactory, except that a variable condenser is desirable across the grid circuit of the first valve. Secondly, reaction coil, if used, should be introduced in the plate of the first valve instead of the second. Thirdly, reaction of this type may only be used under the conditions laid out in our note at the head of these columns.

**"H.L.H." (S.E. 18)** *describes his crystal set and asks* (1) *If the set will work.* (2) *If a telephone condenser is necessary.* (3) *The wavelength of set.* (4) *For any suggested improvements.*

(1) Yes, if correctly connected up. (2) Not essential, but will generally improve results. (3) Maximum about 3,000 metres. (4) A double circuit receiver with a loose coupler would give greater selectivity.

## SHARE MARKET REPORT.

Prices as we go to press on September 8th are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 8 | 0 |
| ,, Preference .. .. | 2 | 4 | 4½ |
| ,, Inter. Marine.. .. | 1 | 9 | 6 |
| ,, Canadian .. .. | | 11 | 3 |

Radio Corporation of America:—

| | | | |
|---|---|---|---|
| Ordinary .. .. .. | 1 | 2 | 0 |
| Preference .. .. .. | | 14 | 0 |

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THE
# WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

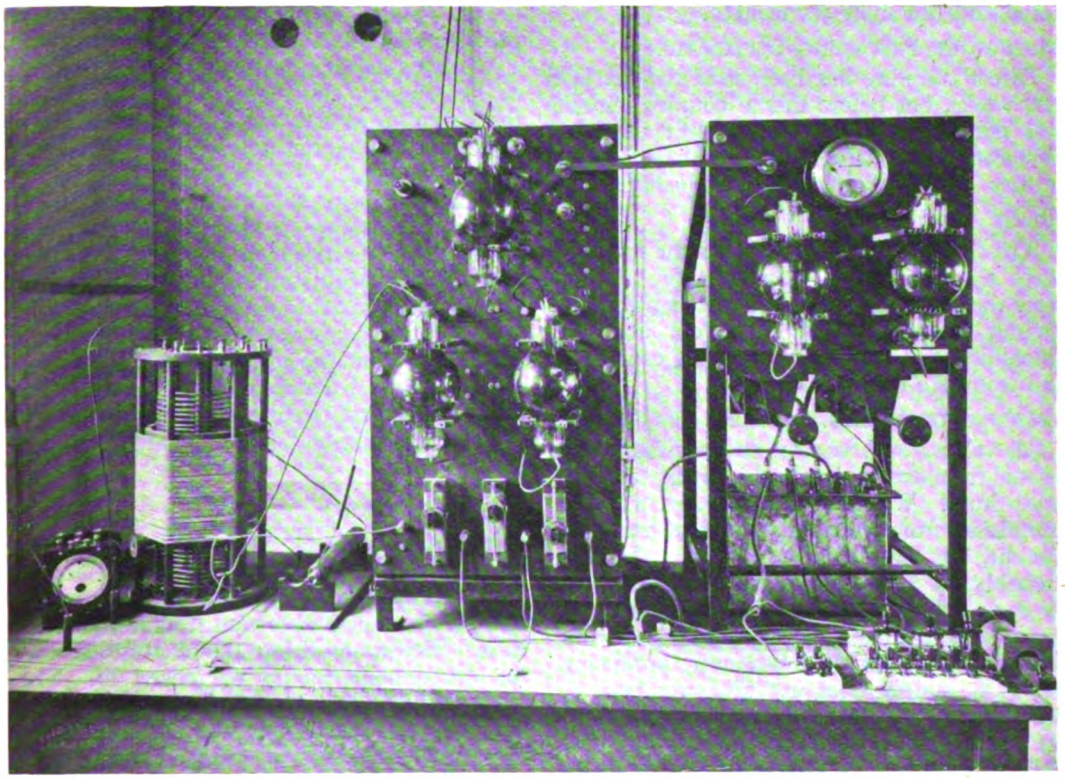
VOL. X. No. 26. SEPTEMBER 23RD, 1922. WEEKLY

## 2 MT Writtle

### A Description of the Transmitting Plant

By CAPTAIN P. P. ECKERSLEY.

AT the outset it should be clearly understood that the transmitter at Writtle does not employ any novel circuits, the results, such as they are, are obtained by attention to detail rather than by resource to high falutin' and theoretically perfect methods. The set is in fact adapted from an old telephone transmitter designed for other purposes. The set was erected and is maintained and run by a staff engaged principally on experimental commercial work, and the station is run out of hours, so that a great deal of time cannot be spared for further research and experiment on this particular transmitter.



*The ¼ k W set used for the Tuesday evening's telephony transmissions.*

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THE AERIAL.

The aerial is of L construction, and consists of four parallel wires equally spaced on a 12-ft. spreader slung between two masts, 100 ft. high, 200 ft. apart. An earth screen is used in place of the ordinary earth, and this provides a low resistance aerial system.

The effective height of the aerial is about 20 metres, and this gives a radiation resistance at 400 metres of

$$\frac{1600\ (20)^2}{(400)^2} = 4 \text{ ohms.}$$

POWER.

The power is ¼ kW, and this gives about 4 amps in the aerial. Assuming a 60 per cent. efficiency, this gives the total resistance of the aerial system as about 9 ohms, or 5 ohms for the aerial and aerial inductance, and 4 ohms for the radiation resistance, giving a radiation efficiency of nearly 50 per cent.; an extremely good figure, thanks to the low resistance aerial and the short wavelength.

METHOD OF PRODUCING OSCILLATIONS.

Direct coupling has been used for the last few weeks, but before this a coupled circuit was employed. It is not thought that the abolition of the coupled circuit has resulted in any deterioration of speech quality.

POWER SUPPLY.—H.T. VOLTAGE.

The H.T. voltage is produced in the standard way, by rectifying the alternating currents from the secondary of a 4,000 volt transformer. Double rectification is employed, and the smoothing is helped by a large condenser and iron core choke.

LIGHTING OF VALVES.

All valves, both control and oscillator, are lighted from accumulators, this giving freedom from hum. We have occasionally received complaints from some amateurs that hum was present, but from their descriptions this was probably not due to the alternator, but possibly to some breathing noises in a temporarily packed microphone. It is practically certain that the use of alternating current for producing the H.T. supply does not give any hum in the carrier wave, provided suitable precautions are taken. It is essential, however, to use D.C. lighting for the valve filaments if silence is to be obtained.

METHOD OF CONTROL.

The well-known method of choke control is used, and practically all the subsidiary control circuits use iron in the circuits. From the point of view of strict theory, distortion should arise from the use of "iron circuits," but in practice it is not thought that this distortion is at all serious, and the simplicity and efficiency of the usual choke control circuit amply compensates for its theoretical disadvantages. Many argue that the necessary blocking condenser connected (as regards the speech circuits) across the choke, must bring in a measure of resonance, and may produce "wolf notes" in musical reproduction, but the heavy damping in the circuit makes the effect very slight. Undoubtedly, however, the unpleasant ringing or hanging-on sounds in musical production by wireless telephony are due to the partial resonance in the control circuits. (This effect, by the way, is often endemic to receivers, hence it is bad to use too much low frequency magnification. Again, phones are always semi-tuned, and produce the ringing quality in speech and music so often heard. Thick diaphragms heavily damped produce best quality, but are very insensitive.)

We have repeatedly proved that the ringing or hanging-on effect gets worse the greater the control; in fact the less the control the better the quality, but unfortunately we cannot please the single valveites at 100 miles if we cut down control too much. The London amateur, however, is better pleased with what is merely a ripple on top of strong C.W.

In the control system at Writtle, every care has been taken to damp out tuned circuits and to prevent any reaction in the amplification chain from the microphone to the main control valves. Spurious low frequency reaction in control circuits is a frequent cause of the "hanging-on" effect and the emission of wolf notes.

THE MICROPHONE.

An ordinary 6-volt Peel Connor has been used since the inception of the concerts. The microphone is probably at the root of most of the music distortion troubles, good as it is. Before touching the control circuits the microphone should be looked to. The microphone as it stands to-day was produced for speech; it was never intended for music. By dint of much research work it has been made to hear, close up to the mouth of the speaker, the sounds being concentrated by a small trumpet, what the human ear, complicated by holes and cavities, hears at a much greater distance. We are now asking

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it to hear, still close up to the disturbance, sounds which may differ in frequency in the ratio of 8-1 exactly as the human ear hears them in a large room.

The diaphragm of a microphone has a natural period and tends to give prominence to sounds of that period, hence the awful hoarse grunt that a low piano note gives, the excellence of a violin or soprano, and the poor quality of instrumental harmonised works.

What we really want is an absolutely aperiodic diaphragm which will respond equally to any note within the eight octaves, will be fully sensitive, and will react to sound disturbances much as does the human ear.

So far this ideal can often only be obtained by very insensitive arrangements which require, therefore, electrical amplification, and unless this is very carefully done results in as much distortion as was originally present, due to the more sensitive but less distortionless microphone.

CONCLUSION.

Good quality in wireless telephony is as elusive as good character in human beings, and is as seldom met with. It depends upon such an enormous number of variables that it is marvellous that anything approaching faithful reproduction of music ever results. Sound impinges on a semi-tuned diaphragm casually pressing on small pieces of carbon, the changes of electrical current so produced influence an iron transformer which is greatly non-linear in effect. The secondary of the transformer is only effective in producing current changes in a valve for half its working period, and energy may be absorbed in grid current only for the greater intensities. More iron transformers intervene, some semi-tuned by condensers before another non-linear and half-effective valve once more mars a chain that should be strictly linear. The voltage variations are applied to the high frequency medium and are radiated across miles of attenuating country and finally fall on an aerial tuned to only a few of the frequencies out of the many that are asking for recognition. The high frequency amplification is at least distortionless, but the rectifier necessarily cuts out one half of the disturbance which again is put through perhaps two or three iron transformers and finally manages to waggle semi-tuned diaphragms in the phones. These produce pressures and rarefications of air in the confined space between ebonite earpieces and the flesh of the hearer's ears . . . and sounds are expected in this space, exactly corresponding to those impinging upon the microphone. Truly the human ear is a marvellous piece of apparatus!

In spite of this, exceedingly good quality can be obtained, but this will only result after strict attention has been paid to detail both at the transmitting and receiving ends. I would strongly impress on every amateur that good results are dependent upon his skill nearly as much as upon ours.

If broadcasting has done nothing else as yet, it has opened up a great field for the inventor, and a fascinating hobby for those with scientific leanings. It is hoped in time that research and experiment will bring the art to such a perfection that broadcast concerts will be a real aid towards musical appreciation throughout the country, and it is hoped that this ideal may be brought nearer by the efforts of British amateurs.

The Next Meeting of the Wireless Society of London will be held on Wednesday, September 27th, at the Institution of Electrical Engineers, Victoria Embankment, at 6 p.m.

The Editor will welcome additions to the Directory of amateur transmitting stations for early publication. There are still many holders of transmitting licences who have not supplied particulars.

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# The Unit System as applied to a Wireless Receiving Installation (*Concluded from p. 782*)

By W. FORBES BOYD.

REFERRING to the diagram Fig. 2, p. 780, it will be seen that most leads, with the exception of the grid leads, are carried across each panel so that the necessary connection can be made to the next panel. It will also be noticed that the plate circuit of the rectifying valve is connected to the reaction coil in the usual manner, except that the plate circuit is broken between the transformer and the positive high tension lead, instead of the more orthodox method of breaking the plate circuit between the plate and the transformer.

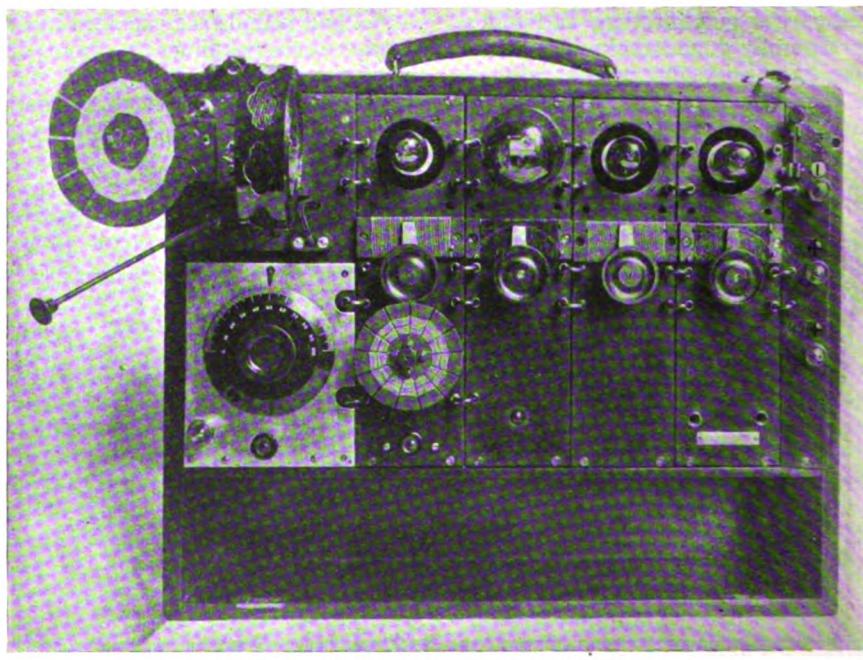

*Fig.* 8. *Tuner with four-valve amplifier.*

This is done so that only one extra reaction link tapping has to be brought back through the H.F. amplifying panel to the tuner, since the positive high tension lead is brought to the H.F. amplifying panel in any case. Apart from these features the amplifying section has no special points.

Fig. 8 shows a photographic view of the complete receiver with tuner and four-valve amplifier, and in order to show the flexibility of the system a two-valve amplifier with tuner unit is given in Fig. 9, this combination exactly fitting into the instrument section of a short wave tuner box.

In comparison with Figs. 2 and 8, it will be seen that Fig. 9 omits the H.F. and L.F. amplifying units.

When using the four-valve amplifier with H.F. amplifier unit it is sometimes an advantage to convert it into a three-valve L.F. amplifier, especially for the longer wavelengths beyond the range of present-day telephony. This is very quickly done by connecting the grid link socket in the tuner marked " A," Fig. 2, with the grid link socket of the rectifying valve marked " B," and switching off the filament of the H.F. amplifying unit.

A very useful accessory to the terminal unit could be added in the form of a flash lamp bulb in series with the positive high tension terminal unit to act as a fuse for the H.T. battery.

The writer invariably uses one on the H.T. battery, and it has many times saved the price of a new battery.

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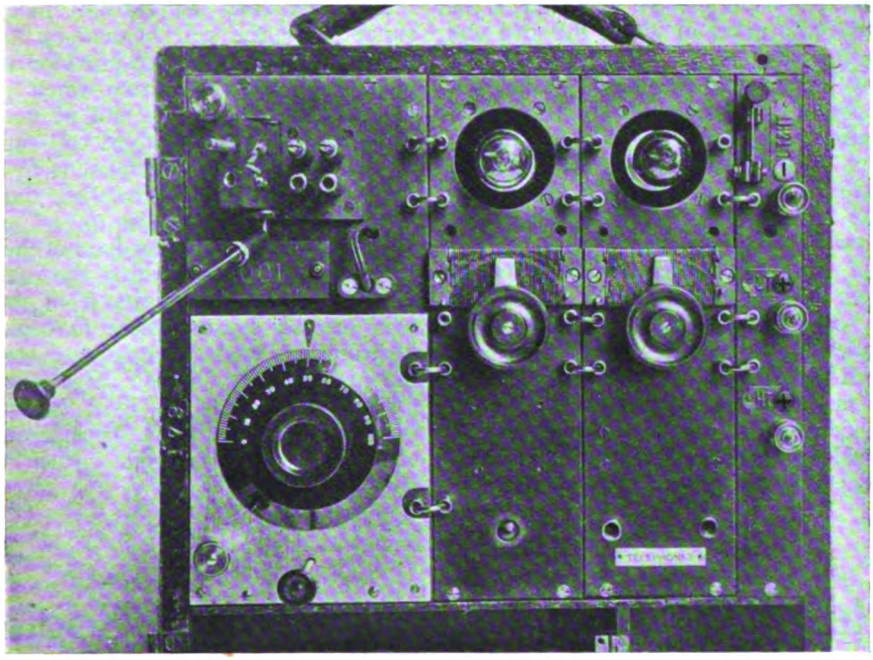
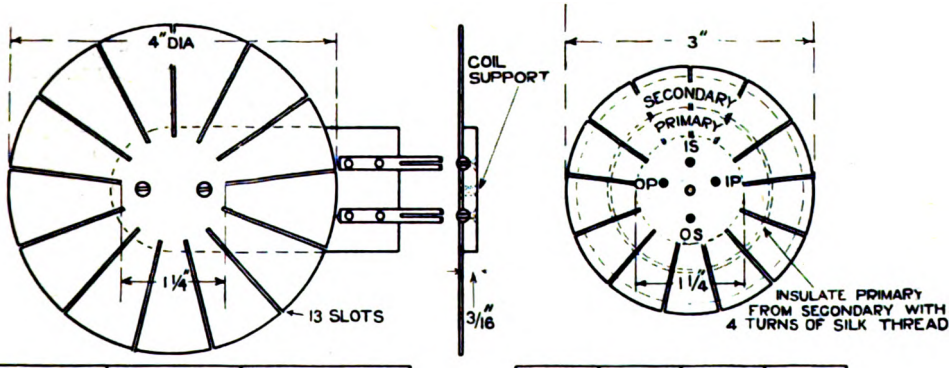


*Fig. 9. Tuner, L.F. rectifying, telephone and terminal units. Illustrating the flexibility of the system.*




| No of Turns | Size of Wire Double Cotton Covered | Wave length with 100 ft Aerial |
|---|---|---|
| 25 | 26 SWG | 200 - 300 m |
| 35 | 26 " | 230 - 370 " |
| 45 | 26 " | 275 - 450 " |
| 55 | 28 " | 330 - 530 " |
| 65 | 26 " | 390 - 640 " |
| 75 | 30 " | 455 - 740 " |
| 85 | 30 " | 550 - 860 " |
| 100 (Duo lateral) | 28 " | 840 - 1350 " |

For Reaction Coils when using H F Amplification use 25 Turns with 35 Turns Aerial Inductance and 35 Turns with all other sizes of Inductance

| No of Turns Primary | No of Turns Secondary | Wave length with .0001 Mfd | Remarks |
|---|---|---|---|
| 35 | 40 | 180 - 290 | m |
| 50 | 60 | 250 - 375 | " |
| 75 | 90 | 360 - 600 | " |
| 100 | 120 | 550 - 780 | " |
| 150 | 200 | 760 - 1100 | Separate Pancakes for P & S |

In all cases Primary & Secondary wound in same direction with No 42 Single Silk Covered Copper Wire

*Fig. 10. Aerial inductances and reaction coil.*

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For example, a faulty valve was used in the H.F. amplifying panel in which the grid was touching the plate.

On any other panel this result would not be so apparent as the grid leak would provide a high resistance, but on the H.F. amplifying panel the faulty valve constituted a short circuit across the H.T. battery, and a twopenny flash lamp bulb is considerably less expensive than a new H.T. battery.

Fig. 10 gives particulars of the coils for the shorter wavelengths. It will be noticed that the aerial inductance and reaction coils are mounted on a 3/16-in. support, and provided with two pins. The grooves for these pins are made by drilling two supports that are clamped together, and if a pin and socket were provided it would be necessary to increase the thickness of the support.

In order that the two-pin mounting be suitable for the coil holders on the tuner, these top coil holders are provided with loose pins which are withdrawn when using the two-pin coil holder. It will be noticed that there are two pairs of fixed coil supports on the tuner. This arrangement is to allow for the difference in width between the pancake and the duo-lateral coils.

In conclusion, the writer has not the slightest hesitation in recommending the unit system to all wireless enthusiasts, from the novice who scarcely knows where to begin to the eardrum-hardened experimenter to whom the unit system should especially appeal, for not only is it an ideal experimenters' system, but also it is considerably more efficient than the single panel type of apparatus.

# Why I Should Join a Wireless Society

By F. HOPE-JONES, M.I.E.E.

(*Chairman of the Wireless Society of London*).

BECAUSE man is a gregarious animal and identity of interest breeds friendship; because the easy and quick way of acquiring the special knowledge you want is to compare notes with others who are engaged upon the same problem.

Such reasons are the obvious ones, but there are others less conspicuous, and as is usually the case it is those below the surface that are the more important.

Your keenness in the new hobby may well lead you to consider who gave you radio-telegraphy. I am not thinking at the moment of the scientists; your text books will teach you what you owe to Clark Maxwell, Hertz, Lodge, Marconi, and Fleming, but do you realise that only six months ago it was technically against the law to transmit or receive wireless telephony in this country? Who fought for that very moderate degree of freedom which you now enjoy or are promised? *Your fellow amateur!* It was he, by joining his local society, who helped to establish the annual conference and enabled us to speak with a voice so unanimous and so authoritative that it had to be listened to. The petition presented to the Postmaster-General in December last was signed by sixty societies affiliated to the Wireless Society of London, and what rapid developments we have seen since then!

Of all the definitions of a gentleman, the one I like best is "he who puts more into life than he takes out." I think all wireless men must be gentlemen, for they are always helping each other and have an eye to the common good.

Apart from ever present technical details of absorbing interest there are many important matters for discussion at this season's meetings. The precise terms of the licences, broadcasting and experimental, are now "in the melting pot," and are of vital concern to us all; the attempt to communicate with the American amateurs on short wave, by way of return for their successful transmission last winter, is a job that can only be done collectively—unless you are a member of a Society you can have no share in it. The forthcoming exhibition will be as full of meat as an egg, and you will need help to assimilate it; and there is much more to be said about broadcasting in all its aspects. So seek out the Secretary of your local society, hear all about these interesting matters, and throw your talents into the common stock in return for the instruction tips, wrinkles, and other valuable help you will receive.

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# Meteorological Wireless Codes.

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

In the last instalment of this article (pp. 745–749) the coded forecasts for districts were considered. We will now pass on to the form of synoptic reports issued by the Air Ministry.

*N.B.*—The meaning of the Code letters is explained in the New International Code below. Groups of letters in inverted commas are not in code.

0200 *message.* 0600 *message.* 1400 *message.*

(*a*) $I_nI_n$ BBBDD FwwTT cbWVH ALaNh $C_1$ddVV

(*b*) "Pilot" $I_nI_n$ $h_1$ddvv $h_1$ddvv etc.

(*c*) "Temp" $I_nI_n$ ddtt BBTTH etc. (dd = day of month, tt = hour of observation G.M.T.)

(*d*) "Ships" QLLL$x_1$ llll$x_2$ BBDD$x_3$ FvKd$x_4$ wwGG$x_5$ TTtt$x_6$ CNW$rx_7$ $y_1$ $y_2$ $y_3$ $y_4$ z. (llll = long. in degrees and tenths; other symbols in New International Code.)

0800 *message.*

(*a*) $I_nI_n$ BBBDD FwwTT cbWVH ALaNh RRmmr $C_1$ddVV (for Inland stations only). $I_nI_n$ BBBDD FwwTT cbWVH ALaNh RRSV$_s$r $C_1$ddVV (for coastal stations only).

(*b*) (*c*) and (*d*) Same form as 0200 message.

1900 *message.*

(*a*) $I_nI_n$ BBBDD FwwTT cbWVH ALaNh RRMMr $C_1$ddVV (for inland stations only) $I_nI_n$ BBBDD FwwTT cbWVH ALaNh RRSV$_s$r $C_1$ddVV (for coastal stations only).

(*b*), (*c*) and (*d*) as 0200 message.

The reporting stations with their index numbers ($I_nI_n$) are given in the map, p. 820, where C = coastal station, L = inland station. Stations usually reported are in capital letters.

*Aviation Reports.*

*Messages at* 0335, 0435, 0535, 0635: "Meteor" (four-figure group indicating time of observations, *e.g.*, for 0335 message group = 0300). (*a*) (stations 61, 62, 66) x $I_nI_n$ (Vs) wwVhL NDDFW. (Ob. at Croydon 5 min. before transmission of message) "CDN" wwVhL.

[*Note.*—x = units digit in sum of figures wwVhL.]

*Messages at* 0735 (*a*) "Meteor" 0700.

" 1335 (Stations 61 and 66) $I_nI_n$ (V$_s$) BBBDD FwwTT cbWVH ALaNh $C_a$ dd$F_1$S. (Stations 62, 75) x $I_nI_n$ (V$_s$) wwVhL NDDF $C_a$ dd$F_1$S. W

(*b*) (Stations 61 *OR* 66) $I_nI_n$ 49tt $h_1$ddvv (tt = hour of pilot balloon ascent). (Ob. at Croydon 5 min. before transmission of message). "CDN" ww VhL.

*Message at* 0835 (*a*) "Meteor" 0800 (stations 61, 62, 66) x $I_nI_n$ (Vs) wwVhL NDD FW, followed by reports received too late for inclusion in general synoptic report issued at 0800 and in same code.

(*f*) "Forecast" (in same code as synoptic reports for *districts*). "CDN" wwVhL.

*Message at* 0935 (*a*) "Meteor" 0900 (stations 61, 62, 66, 75) x $I_nI_n$ (Vs) wwVhL NDDFW (station 76) $I_nI_n$ Vs.

(*b*) Same form as 0735 message (only included if no pilot balloon ascent was available for the 0735 message and one has become available since). "CDN" wwVhL.



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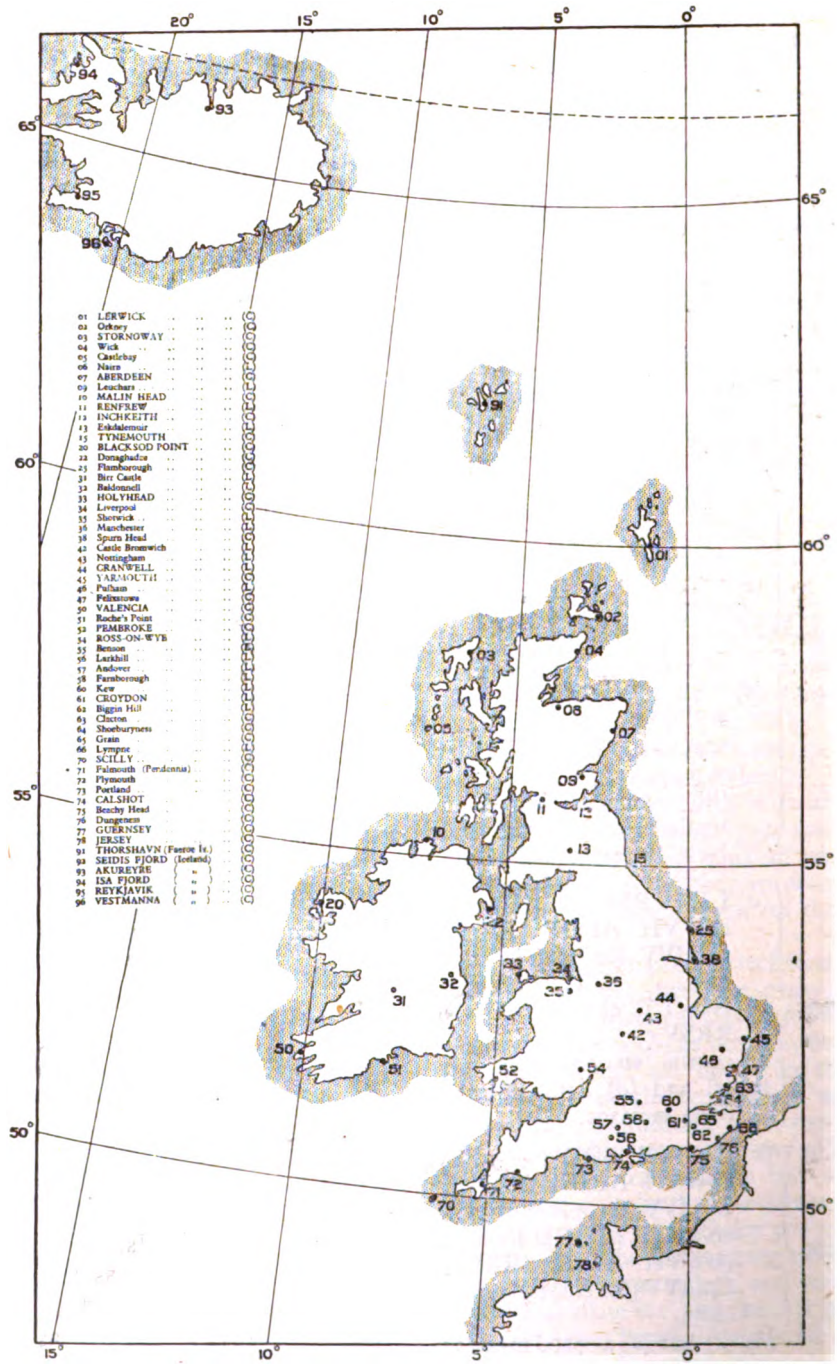


*Map showing Reporting Stations with their index numbers.*

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*Message at* 1035 (*a*) " Meteor " 1000 (stations 61, 62, 66) same form as (*a*) 0735 message.
(Stations 50, 72, 74) $I_nI_n$ BBBDD FwwTT cbWVH ALaNh.
" CDN " wwVh.

*Message at* 1135 (*a*) " Meteor " 1100 stations 61, 62, 66, 75). x $I_nI_n$ ($V_s$) wwVhL NDDFW.

(*b*) (Stations 61 *OR* 66) $I_nI_n$ 49tt $h_1$ddvv.

(*f*) " Forecast " [same code as 0835 $(f)_3$ " CDN "wwVh L.

*Message at* 1235 (*a*) " Meteor " 1200 (stations 61, 62, 66, 75, 76) in same code as 0935 (*a*) message. " CDN " wwVhL.

*Message at* 1435 (*a*) " Meteor " 1400 (stations 61, 62, 66) in same code as 0835 (*a*) message, followed by reports too late to be included in synoptic message at 1400 and in same code.

(*f*) " Forecast " [same code as 0835 (*f*)] " CDN " wwVhL.

*Message at* 1535 (*a*) " Meteor " 1500 (stations 61, 62, 66, 75, 76) in same code as 0935 (*a*) message " CDN " wwVhL.

*Message at* 1635 (*a*) " Meteor " 1600 (stations 61, 62, 66) in same code as 0735 (*a*) message. " CDN " wwVhL.

*Note.*—The word " Botley " when it occurs in a message is followed by a statement in plain language of the conditions on the North Downs (Botley Hill) as viewed from Biggin Hill, when such a statement adds material information to that contained in the rest of the message.

## THE NEW INTERNATIONAL CODE.

A = Form of *predominating cloud* lowest in the scale of cloud forms.

a = Form of *predominating cloud* highest in the scale of cloud forms when more than one type of cloud exists.

BBB = Pressure in millibars and tenths (initial 9 or 10 omitted) or millimetres and tenths (initial 7 omitted).

BB = pressure in *whole* millibars or millimetres (initial 9, 10 or 7 omitted).

b = amount of barometric tendency during the 3 hours preceding the time of observation expressed in half-mbs. or half-mm.

C = form of predominating cloud when only one form is reported (see ship observations).

$C_1$ = form of cloud observed by nephoscope.

$C_n$ = form of cloud obesrved by nephoscope in aviation reports.

c = characteristic of barometric tendency during the period of 3 hours preceding observation.

DD = direction of wind near the ground on the scale (01-32) in which 08 = east, 16 = south, etc. 00 = calm.

dd = direction of wind in the upper air or of cloud movement on the scale (01-36), *i.e.*, degrees from North divided by 10 to nearest whole number, 00 = calm.

d = direction from which swell comes scal, (0-8) in which 2 = east, 4 = south, etc., 0 = no swell.

F = force of wind on Beaufort Scale.

$F_1$ = approximate speed of low cloud.

GG = Greenwich time of ob. (01 = 1 a.m.e 12 = noon, etc).

H = relative humidity of the air.

h = height of base of lowest cloud present.

$h_1$ = height at which upper wind is reported.

$I_nI_n$ = index number of station.

K = characteristic of the swell in the open sea.

L = amount of sky (scale 0-10) covered by cloud form A.

LLL = latitude in degrees and tenths, the tenths being obtained by dividing the number of minutes by 6 and neglecting the remainder.

lll = longitude in degrees and tenths (as for LLL).

MM = maximum temperature in the interval of 11 hours ending at 18h. G.M.T.

mm = minimum temperature in the interval of 13 hours ending at 7h. G.M.T.

N = Total amount of sky covered with cloud.

Q = quarter of the globe in which ship is situated.

RR = rainfall at 7 a.m. for preceding 13 hours. and at 6 p.m. for preceding 11 hours.

R = amount of rainfall for the preceding 24 hours.

r = time of commencement of precipitation.

S = state of the sea and swell (coast stations).

TT = temperature of the air in whole degrees F or C (50 added to negative values).



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tt = temperature of the sea (surface water) in whole degrees.

TTT = temperature of the air in degrees and tenths F. or C. (500 added to negative values).

ttt = temperature of the sea in degrees and tenths.

V = visibility or distance at which objects can be seen in daylight or at which lights can be seen at night.

v = visibility at sea from ships at sea.

$V_s$ = visibility towards the sea (from coast stations).

VV = the relative speed of clouds as determined by nephoscope and such that the actual speed of the cloud will be given in km/hour by the equation $VV = \frac{h}{1,000} VV$, if $h$, the height of the cloud is expressed in metres.

vv = speed of wind in the upper air in km/hour or mi/hour.

W = weather in the interval since the preceding time of report.

ww = the actual weather at the time of ob. with which is combined, whenever possible, the general character of the weather.

$x_1$ = a check figure obtained by adding the first four figures of the group and taking the units figure in the sum thus obtained.

$x_2$ $x_3$ $x_4$ $x_5$ $y_1$ $y_2$ $y_3$ $y_4$ = check figures.

z = key figure, obtained by adding all the x's or all the y's.

# The All-British Wireless Exhibition

AS we go to press with this issue we learn that the arrangements for the forthcoming All-British Wireless Exhibition to be held at the Horticultural Hall, Westminster, are in full swing.

The hearty co-operation of all those who are taking part in the Exhibition ensures that the event will be one well calculated to absorb the interest of the public at a time when the popularity of wireless is likely to receive a tremendous impetus.

Those who attend the Exhibition are not likely to come away disappointed with the display of equipment which will be laid out for inspection.

There is little doubt that the exhibitors will confine their attention almost exclusively to the interests and requirements of the experimenter, the amateur and the general public, and therein will be noticed a distinction between this exhibition and those exhibitions not of an " all-wireless " category which have been held in the past where the apparatus shown has been principally of a type designed for handling commercial telegraph traffic.

All the most up-to-date designs of complete sets and parts will be on show, and just as the annual motor exhibition is regarded as the opportunity for the public and prospective purchasers of automobiles to make their choice from all the best that can be displayed, so this Exhibition will fill the same place in affording similar opportunities to those who have interests in wireless.

One cannot help feeling that, to the general public at any rate, a visit to the Horticultural Hall during the week of the Exhibition will be somewhat of a revelation. There must be many who have hardly any acquaintance with wireless beyond perhaps what they have recently read in the daily press, and what they may have gleaned from this source will have served only as an inducement to take a fuller interest in the subject.

For those who already are associated with wireless, the Exhibition will afford an excellent opportunity for initiating friends into the fascinations of the science, and no doubt those who are members of societies especially, will see to it that visitors from their district are accompanied, as far as it is possible to arrange it, by some member who is competent to point out and explain wireless matters so as to add to the enjoyment and profit to be derived from the visit.

No doubt Secretaries of Societies will

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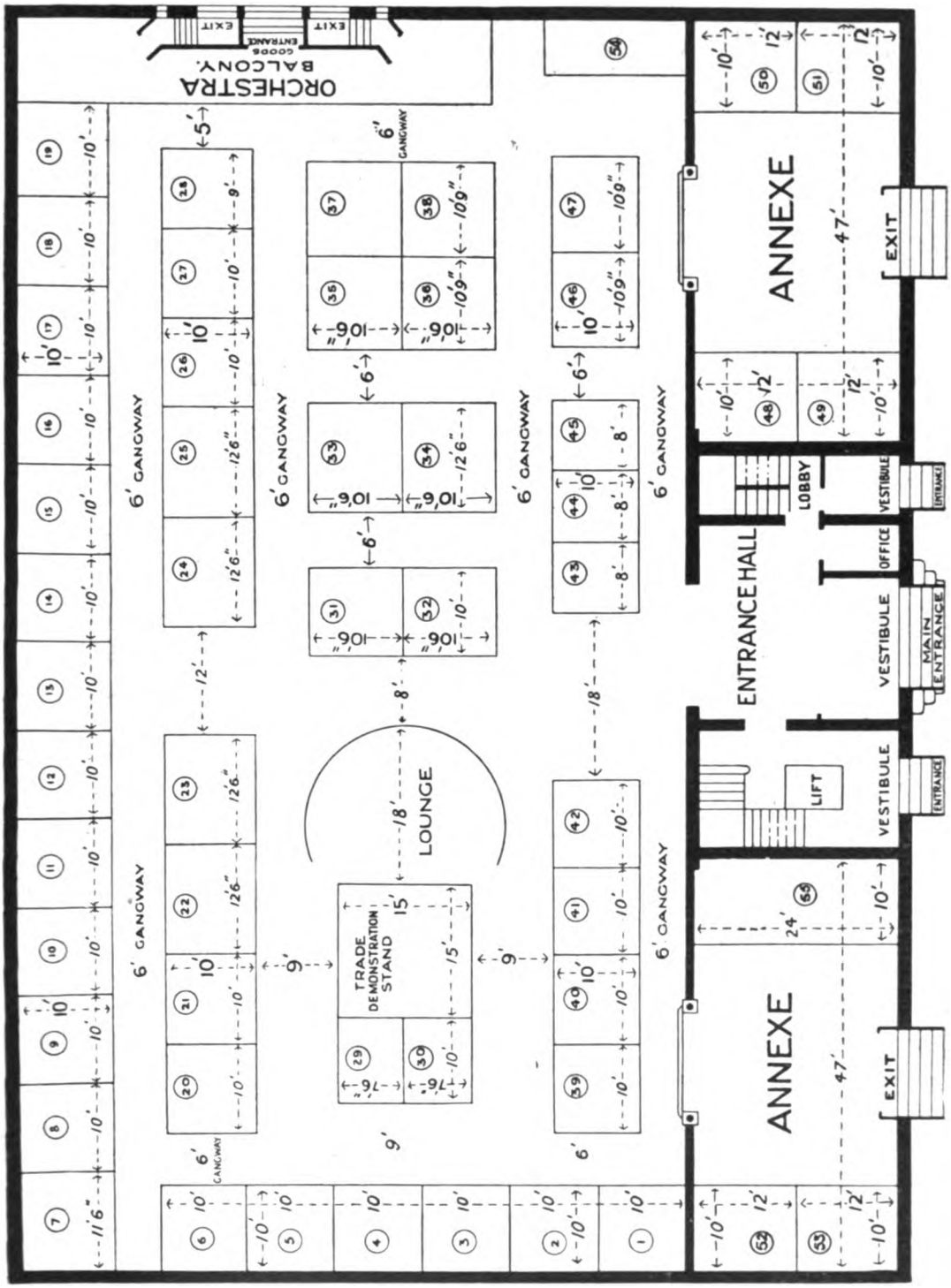


*Plan of the Horticultural Hall.* *For Key see page 824.*

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endeavour to arrange for parties to visit the Exhibition with this object in view, and such an arrangement will no doubt result in a large influx of new members to the societies.

As has already been announced, the Wireless Society of London is making special arrangements in connection with the social side of the Exhibition, and will be prepared to welcome members of societies and particularly those of provincial societies for whom the Exhibition may afford an opportunity of meeting London society members which they might not otherwise have.

For those who come to London specially for the event and who may have only one day to spare, it is suggested that where possible some day other than a Saturday might be chosen, since on Saturdays it is likely that the Hall will be very full and some difficulty might be experienced in seeing everything as well as meeting socially some of their London friends.

The Wireless Society of London has obtained the services of a number of lecturers who will conduct special lectures, chiefly of a popular nature, for the benefit of visitors to the Exhibition. Such lectures will be held in a lecture room specially provided for the purpose. The following are the names of those who have already kindly promised to give lectures :—

Admiral of the Fleet, Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S., D.Sc., M.I.E.E.
Mr. A. A. Campbell Swinton, F.R.S.
Mr. F. Hope-Jones, M.I.E.E.
Mr. Maurice Child.
Mr. G. P. Mair, A.M.I.C.E.
Mr. G. G. Blake, M.I.E.E., A.Inst.P.
Mr. E. Blake, A.M.I.E.E.
Mr. Philip R. Coursey, B.Sc., A.M.I.E.E.,F.Inst.P.
Mr. W. R. H. Tingey.
Mr. R. C. Clinker, M.I.E.E.
Mr. John Scott-Taggart, M.C., A.Am.I.E.E., F.Inst.P.
Mr. H. Walker, A.M.I.R.E.
Mr. H. R. Rivers-Moore, B.Sc., A.M.I.E.E.

Below is given a list of the names of those firms who are showing at the Exhibition. This list is arranged in alphabetical order, and alongside each name appears the number of the stand allotted. These numbers form the key to the accompanying plan of the Horticultural Hall, whereon all the stands are given their appropriate numbers.

**2** Messrs. Anode Wireless & Scientific Instruments, Ltd.
**46** Messrs. G. Z. Auckland & Son,
**52** Messrs. Automatic Telephone Manfg Co., Ltd.
**19** Messrs. J. B. Bower & Co. Ltd.
**7** Messrs. British Thomson-Houston Co., Ltd.
**42** Messrs. British Wireless Supply Co.
**43** Messrs. S. G. Brown, Ltd.
**12A** Messrs. Burndept, Ltd.
**30** Messrs. The Chloride Electrical Storage Co., Ltd.
**29** Messrs. A. C. Cossor, Ltd.
**18** Messrs. Coomes & Co.
**36** Messrs. Dubilier Condenser Co., (1921) Ltd.
**55** Messrs. Bertram Day & Co., Ltd.
**11** Messrs. The Ever Ready Co., (Gt. Britain) Ltd.
**50** Messrs. Econ Manfg. Co., Ltd.
**51** Messrs. Economic Electric Ltd.
**45** Messrs. C. F. Elwell, Ltd.
**10** Messrs. Fellows Magneto Co., Ltd.
**47** Messrs. Gambrell Bros., Ltd.
**31** Messrs. A. W. Gamage, Ltd.
**44** Messrs. Alfred Graham & Co.
**26** Messrs. General Radio Co.
**5** Messrs. Harwell, Ltd.
**17** Messrs. Hart Accumulator Co., Ltd.
**12** Messrs. Hambling, Clapp & Co.
**35** Messrs. H. P. R. Wireless, Ltd.
**9** T. H. Isted, Esq.
**4** Messrs. Igranic Electric Co., Ltd.
**8** Messrs. "K. B." Radio Equipment Co.
**38** Messrs. L. McMichael, Ltd.
**41** Messrs. Mullard Radio Valve Co., Ltd.
**24** Messrs. Marconi's Wireless Telegraph Co., Ltd.
**32** Messrs. The Marconi Scientific Instrument Co., Ltd.
**33** Messrs. Metropolitan-Vickers Electrical Co., Ltd.
**21** Messrs. Mitchell's Electrical & Wireless, Ltd.
**28** Messrs. The M.O. Valve Co., Ltd.
**53** Messrs. Pettigrew & Merriman, Ltd.
**16** Messrs. The Peto Scott Co.
**23** Messrs. Radio Communication Co., Ltd.
**37** Messrs. Radio Instruments, Ltd.
**22** Messrs. Rogers, Foster & Howell, Ltd.
**6** Messrs. Radio Service, Ltd.
**27** Messrs. Radio Press, Ltd.
**54** Messrs. Stanley Prince & Co.
**48** Messrs. Siemens Bros. & Co., Ltd.
**49** H. W. Sullivan, Esq.
**34** Messrs. Sterling Telephone & Electric Co., Ltd.
**25** W. R. H. Tingéy, Esq.
**20** Messrs. Telephone Manfg. Co., Ltd.
**15** Messrs. Wates Bros.
**39** Messrs. Western Electric Co., Ltd.
**14** Messrs. Wireless Equipment, Ltd.
**1** Messrs. Wireless Supplies Co.
**40** Messrs. Wireless Press, Ltd.
**3** Messrs. The Zenith Manfg. Co.

It is, of course, not possible at this stage to say anything in detail regarding the apparatus which will be exhibited. No doubt each manufacturer is holding back for the purpose of the Exhibition his most recent productions, and will observe secrecy as to the nature of his exhibits until they are available for inspection on his stand.

In further issues of *The Wireless World and Radio Review* will be described and illustrated some of these attractive features for the purpose of record and for the benefit of those unable to attend the exhibition.

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# The Radio Direction Finder and its Application to Navigation

SHIP owners, wireless engineers, government departments and others, are giving much attention to the importance of providing wireless direction-finding equipment on board ship by means of which the position of a ship can be quickly and accurately determined. This matter is receiving attention in various countries, especially in the United States. The provision of radio direction-finding equipment on a ship may eliminate serious delays caused by a ship being unable to enter port during a fog because its position, or the bearing of lighthouses, is not known. In case of a wreck, such equipment may be the means of saving many lives.

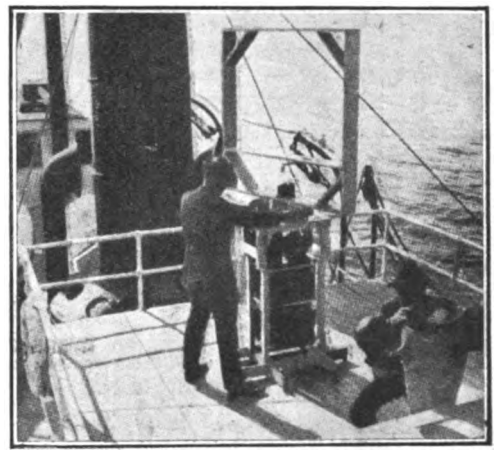
The wireless direction finder is a device for determining in a simple manner the direction of a radio transmitting station with reference to the point at which the direction finder is located. The direction finder has a considerable number of very practical applications, of which one of the most important is its use as an aid to navigation.

Sound and visual signalling devices have been employed for many years as aids to navigation. Lighthouses and lightships, with their characteristic light flashes and sound signals are established and maintained along the coasts and at harbour entrances in order that shipping may be carried on with maximum safety. During fog or thick weather, however, the sound and visual signalling devices often do not give reliable service.

The wireless direction finder is not affected by fog, and has the further advantage that it will operate over much greater distances than sound and visual signalling devices.

The Department of Commerce of the United States has developed a system of wireless direction finding which has proved to be very simple, practical, and dependable. This system has been developed by the Bureau of Standards in co-operation with the Bureau of Lighthouses. The first installations were made in the Third Lighthouse District, with headquarters at Tompkinsville, N.Y. A common type of direction finder which has been used for installation on shipboard, consists of a coil of ten turns of insulated copper wire wound on a wooden frame four feet square, which is mounted so that it may be rotated about a vertical axis. Suitable receiving apparatus is used in connection with the coil, and in recent installations has consisted of a variable air condenser for tuning purposes, a balancing condenser for increasing the accuracy of observed bearings, a six-valve amplifier, having three stages of radio-frequency amplification, a detector, and two stages of audio-frequency amplification, batteries, and suitable telephone receivers.

As the coil is revolved about its vertical axis, the intensity of the signal which is being received from the station whose location is to be determined, diminishes until a minimum is reached, which occurs when the plane of the coil comes to a position at right angles to the line of direction to the radio transmitting station. At this point of minimum signal, the bearing is read on a suitable scale, which may be either a fixed scale or the card of a magnetic compass.



*Experimental type of frame on board ship.*

In developing this system of direction finding, the Bureau of Standards has made a study of the distortion effects which may result from the presence of adjacent objects, such as the mass of a ship, and methods of eliminating errors which such distortion may cause in observed radio bearings. A particularly careful study has been made of distortion effects on board ship and methods for correcting for these effects by calibration.

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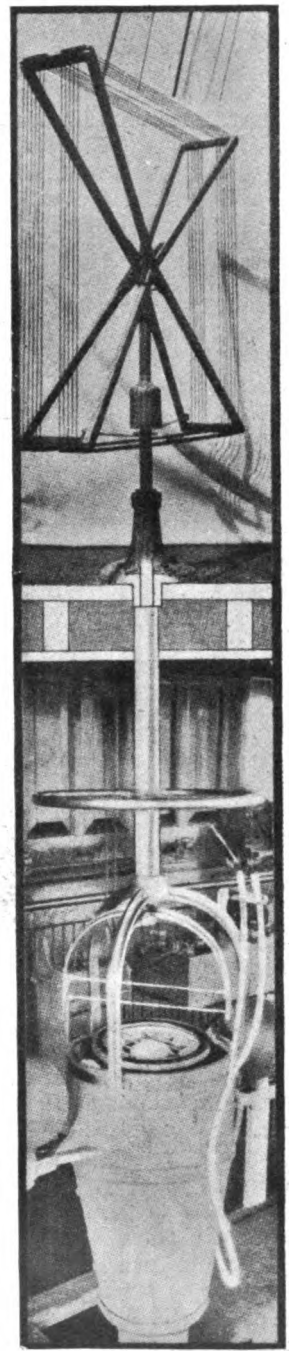

*Magnetic compass with direction-finder attachment for direct reading of bearings.*

Practical methods have been developed for simplifying the operation of the direction finder. The direction finder is essentially a nautical instrument and should be installed on board where it may be used directly by the navigator in taking bearings on wireless stations established on shore or on light vessels. This can be done with the simplified form. Bearings may thus be taken rapidly, at any time, and as often as desired.

This system should be carefully distinguished from the system of determining positions by wireless, in which the ship transmits signals to radio compass stations on shore, which report to the ship its position. This system avoids the delays and errors likely to occur in depending on radio compass stations on shore, since with the latter, even under the most favourable conditions, valuable time may be consumed in making a request for bearings, taking bearings, and getting the information back to the navigator on the ship.

The wireless direction finder as used by the Department of Commerce involves a number of unique features. It is designed to be installed over the ship's binnacle carrying the magnetic compass card, so that the bearings are read directly on the magnetic compass card. An additional scale is attached to the top of the binnacle and marked with the corrections obtained by calibrating the direction finder. By these means the bearings are obtained in a simple and direct manner. The electrical features have been made such that the only operations necessary when taking a bearing are one adjustment in the receiving set, and the rotating of the direction finder coil.

A transmitting station intended primarily for direction finding work is often called a "radio beacon." Radio beacons may be installed at small expense on lighthouses and light-vessels. The transmitting equipment may be designed to operate automatically by simply throwing a switch, so that no additional personnel is necessary. The radio transmitting equipment is set into operation by the lightkeeper, just as the other signalling devices at the light station. The expense of operation of the radio beacon is therefore small.

The Department of Commerce has established three radio beacons at the approaches to New York Harbour, and these are now in regular commission. A radio beacon is being installed on San Francisco Lightvessel No. 70. These beacons have automatic trans-

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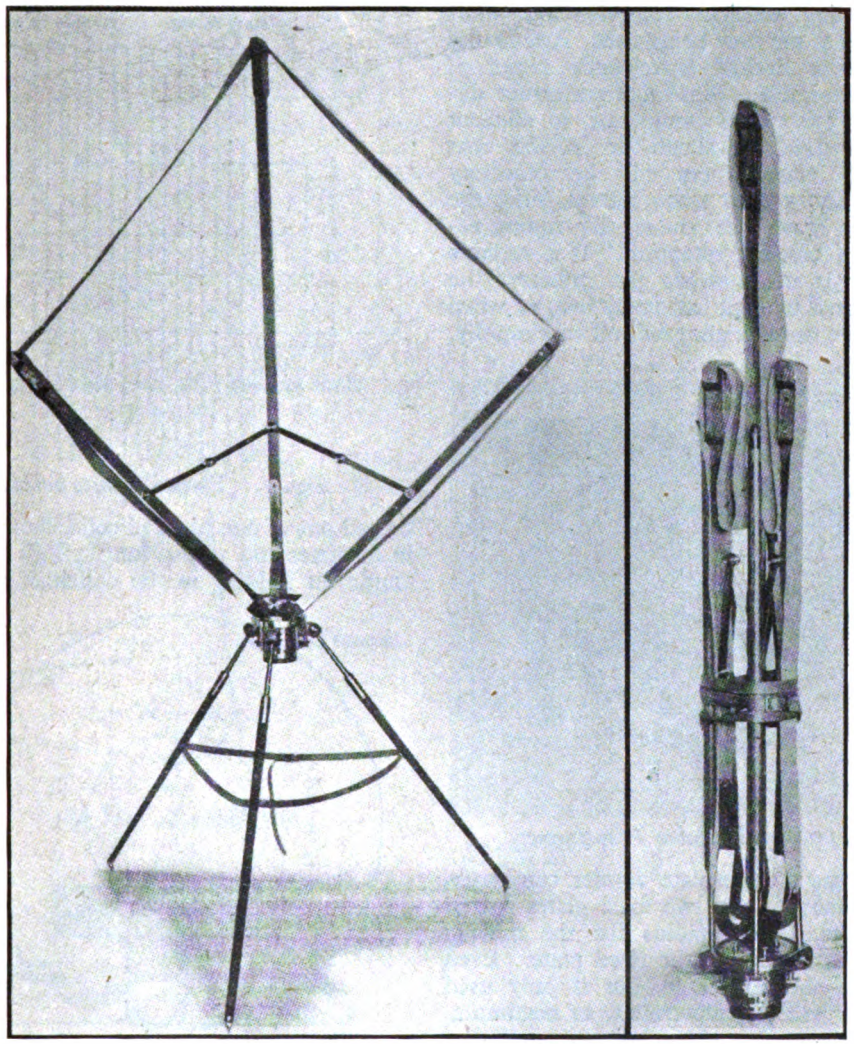
mitting equipment so that no operator is necessary.

The Bureau of Standards has recently issued a publication describing this system of radio direction finding.* This publication shows numerous photographs of a radio direction finder of the type mentioned above, as installed on the pilot house of a lighthouse tender. Actual courses are shown which were run by means of radio bearings taken by the ship's navigator, on the three beacons at the approaches to New York Harbour. In these tests, positions were determined by cross-bearings on the three radio beacons, and courses were set for one of the lightvessel beacons by taking a radio bearing directly on the beacons. The paper deals briefly with the principles of the operation of the direction finder, but is primarily concerned with practical development which has made possible a device sufficiently simple and accurate for use as an aid to navigation, and with practical applications which have been made.



*Collapsible type of direction-finding frame aerial for field use.*

* A new publication issued by the Bureau of Standards, No. 428.

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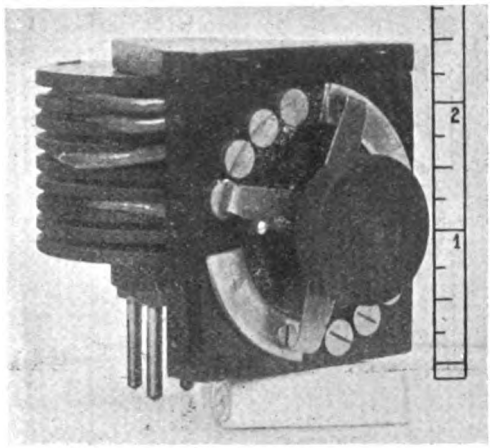
# A Variable H.F. Transformer

By L. W. C. MARTIN.

I DARESAY that in common with myself many amateurs have experienced difficulty in getting efficient reception on short waves such as are now being used. A difficulty arises in the limited wavelength range of H.F. transformers. Since a transformer designed for 350 metres cannot be so efficient on 500 metres, it stands to reason that many H.F. transformers will be necessary to cover, say, 150 to 1,000 metres, since the shorter the wave the closer the tuning required for efficient reception. If a variable condenser is used across the primary, the capacity must be kept extremely low, or when brought into use efficiency falls off very rapidly.



*The finished Variable Transformer.*

I myself use a three-plate vernier condenser, with one moving and two fixed plates spaced $\frac{1}{8}$ in. apart, $1\frac{1}{4}$ in. radius for the moving plate, $1\frac{1}{2}$ in. radius for the fixed plate. Even this is on the large size, but if only used quarter or half the movement, as maximum, it is satisfactory, and will cover any gaps between various wavelengths.

The H.F. transformer I have designed and will describe here with details of construction covers all wavelengths from 350 to 1,000 metres, and is much better to handle than half a dozen small plug-in transformers, whilst being equally efficient on any wavelength. Slight modifications can be made for covering a different range of wavelengths, shorter or longer.

Referring to Fig. 1, this should be as near as possible to dimensions given, and should be

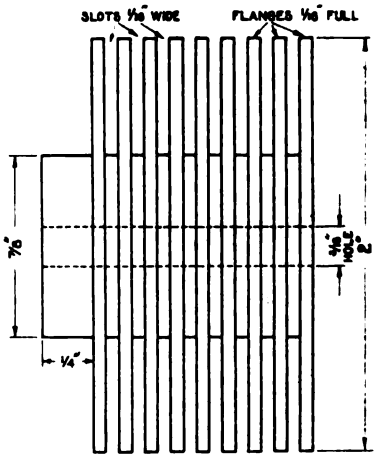



*Fig. 1. Turned ebonite bobbin.*

turned out of one piece of solid ebonite, 2 ins. in diameter and $3\frac{1}{2}$ ins. long. This will allow ample for holding in the chuck of the lathe.

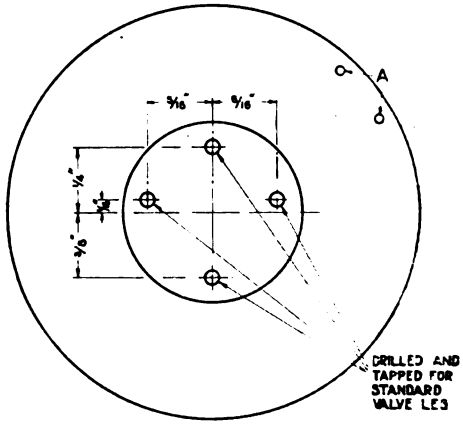



*Fig. 2. View showing setting out of connector pins.*

Fig. 2 shows the bottom of the former drilled and tapped to take ordinary valve legs, which can be purchased for a few pence, and will fit the standard "R" type valve holder.

Fig. 3 is the front of the switch, made of a piece of ebonite 2 ins. square, $\frac{1}{8}$ in. thick, studs $\frac{1}{2}$ in. long, screwed in, leaving $\frac{1}{8}$ in.

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at the back for soldering connection. A small peg screwed in where shown will act as a stop for both ways.

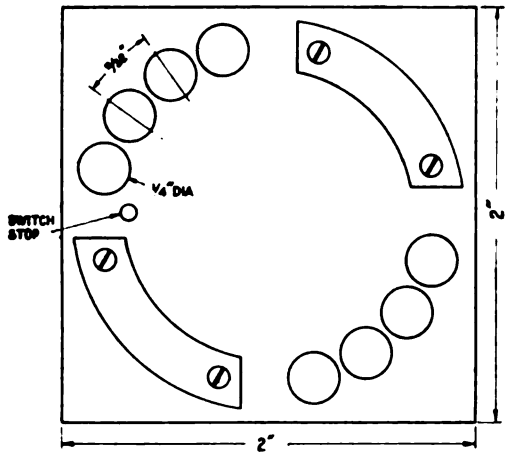


*Fig. 3. Front piece with contact studs and plates.*

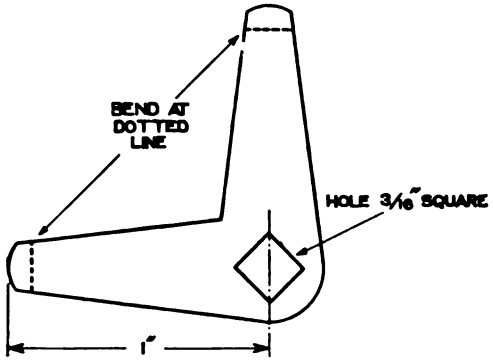


*Fig. 5. A switch.*

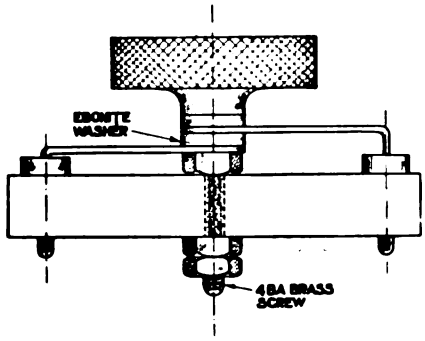


*Fig. 7. Assembled switch parts.*

Fig. 4 is for the contact plates, and can be turned out of brass or bronze, and cut where shown, having two small holes drilled for fixing, one or both fixing screws projecting at the back of the ebonite for connections.

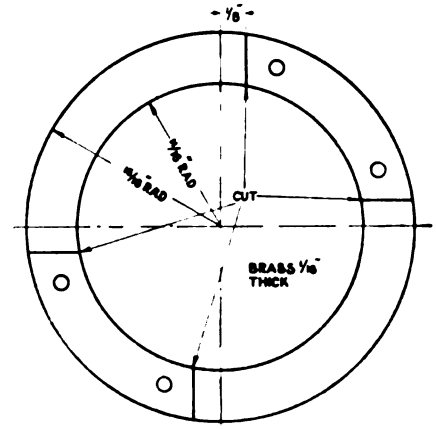


*Fig. 4. Method of cutting contact plates.*

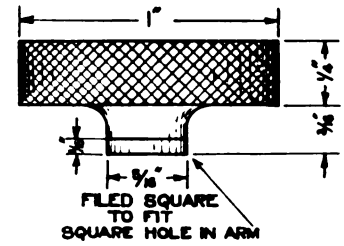


*Fig. 6. Ebonite Knob.*

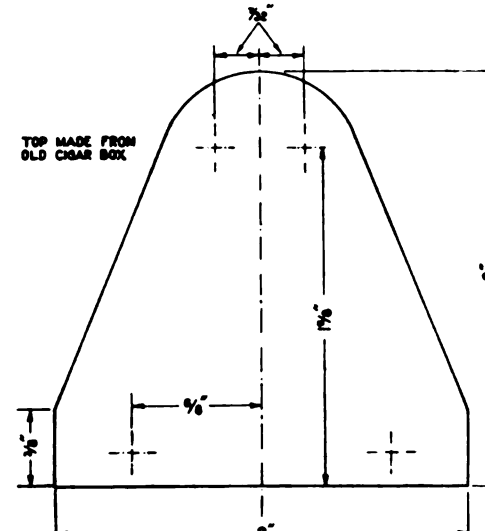


*Fig. 8. End piece for attaching bobbin to switch plate.*

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Fig. 5 shows one switch arm. There must be two of these, the only difference being that one is $\frac{1}{16}$ in. longer, and a 4 B.A. *round hole* in the centre. These can be made of thin springy brass or bronze.

Fig. 6 is the ebonite knob. Great care must be taken in fixing the two arms to see that they do not touch one another. The arm with the square hole should fit on the square part of the knob, and a small ebonite washer $\frac{1}{16}$ in. thick, $\frac{5}{16}$ in. diameter, with a 4 B.A. hole must go between the arms, and be assembled as in Fig. 7.

Fig. 8, I think, will explain itself.

Now wind each slot in the former with 90 turns of 40 S.W.G., S.S.C., copper wire. Care must be taken to wind all slots in the same direction. Every other slot will be primary, secondary, primary, secondary, and so on. If two $\frac{1}{16}$ in. holes are drilled lengthways right through the edge of former, as shown at A, Fig. 2, the wire can be conveniently run from slot to slot, using one row of holes for primary and the other for secondary. Connect the first finish of primary with the second start of primary, and so on until the fourth. Then repeat the same way with the secondary, leaving about 1 in. of wire to spare for tappings, and connect as the diagram Fig. 9.

The first stud covers 350 to 370 metres with half the condenser value; *between* first and second stud 370 to 420 metres. The second stud gives 420 to 600 metres, the third stud 600 to 900 metres, and the fourth stud 900 to 1,100 metres. If this transformer is well made, it is well worth the little trouble involved.

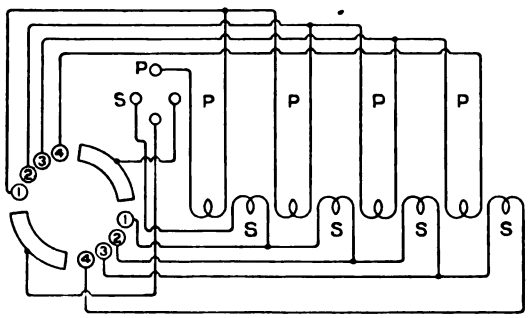


*Fig. 9. Connecting up windings.*

# A Cheap Method of Obtaining H.T. for Telephony Transmission

MOST amateurs possessing transmitting licences are generally very much handicapped by the high cost of high voltage direct current, whether obtained by a generator or by dry batteries. The author has been conducting some experiments for obtaining smooth D.C. suitable for telephony from an induction coil and has met with great success, the cheapness of the method being extraordinary.

The way in which it is done is as follows: First obtain an old induction coil and rewind it for a primary voltage of about 6 to 10 volts, with a step up of about 100:1. The author uses an old Army T.V.T. unit, which is very satisfactory and does not require altering. Having obtained your high voltage alternating current the next step is to rectify it, and for this purpose the ordinary "R" valve will be found entirely satisfactory; to get ten watts, two in parallel should be employed. The plates and grids of these valves are connected together and the current passed through them from filament to plate, taking care to see that the pulse of current at break is utilised as it is much larger than that obtained at make. The direct current thus obtained is very uneven and is of no use for telephony unless it is smoothed out by means of condensers; a condenser of sufficient size to stand 600 volts or more is, however, an expensive item, but quite a suitable condenser can be made for about five shillings by purchasing three 2 MF. Mansbridge condensers and connecting them in series. Using this arrangement the author gets 25 milliamperes at 400 volts and the C.W. is perfectly smooth, giving good telephony. This seems to be a satisfactory solution of the problem of obtaining cheap high tension for telephony transmission.

M. C. E.

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# A Simple Form of High Tension Battery

THE plates of this battery are made of sheet lead about $\frac{3}{32}$ in. thick. They may be cut out by means of shears or a wood chisel, the shape shown in Fig. 1 being the most economical as only the small cross-shaded pieces are waste.

To increase the capacity the surface of the lead is indented or roughened by squeezing it in the vice against a rough file or rasp, one face only of each plate being so treated.

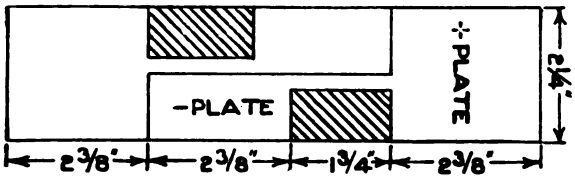


*Fig. 1. Dimensions of the plates.*

The plates are then formed into cylinders by bending them round rods of suitable size, the roughened surface being inside the larger cylinder and outside the smaller.

The most suitable containing vessels are round glass tubes known as " specimen tubes," about three inches high and one inch diameter, obtainable from dealers in chemical apparatus. A wood tray to contain any required number of these tubes is made, allowing about $\frac{1}{8}$ in. between the tubes for insulation, and drilling a number of holes through the bottom for draining spilt acid. The tray may be supported on four ebonite feet.

The inside of the tray is then painted with anti-sulphuric enamel and a framework of ebonite strips fitted into the bottom to support and insulate the cells. Lateral movement at the top of the cells is prevented and insulation secured by rods of glass or ebonite $\frac{1}{8}$ in. diameter, fitted into grooves in the sides of the tray.

When the tubes are in position a small piece of glass or ebonite rod is placed across the bottom of each cell to allow any sediment to fall clear of the plates. To keep the plates from contact with each other within each individual cell, thin perforated ebonite is used, cut to size with scissors, warmed, and bent round the smaller cylinder.

The plates are then fitted into the cells, beginning at the positive end with a single outer cylinder. The connecting strap of the next pair is then bent so that when the negative cylinder is placed in the centre of the first positive, the attached positive will just fit into the second cell. When all the plates are in position, the strap of the last negative (a small single cylinder) and the first positive are fastened to terminals fixed to an ebonite plate screwed to the side of the tray.

The cells are then filled with dilute sulphuric acid (sp. gr. 1180) to the level of the plates, and oil, known as Price's " Blancol," poured on the top to a depth of $\frac{1}{8}$ in., to prevent spraying and evaporation.

The plates are " formed " by the Planté process of charging in one direction and discharging, then charging in the opposite direction and discharging. After this has been done a number of times the cells will be found capable of maintaining a current of

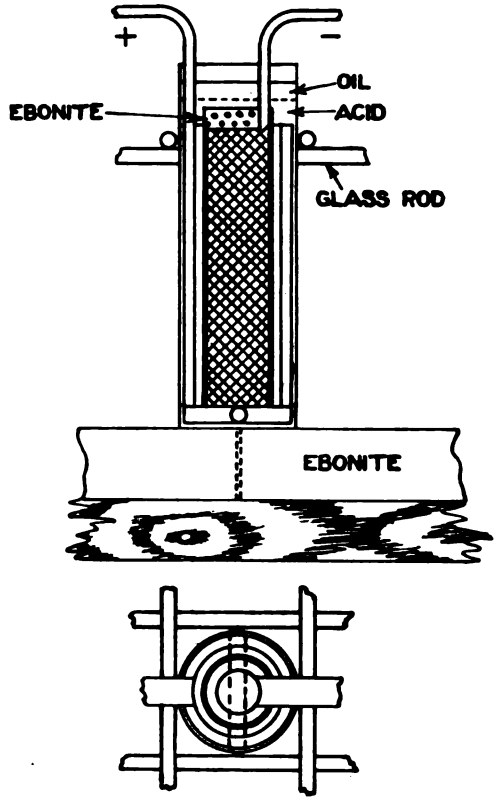


*Fig. 2. The complete cell.*

ten milliamperes for five hours or a smaller current for a longer time.

The rate of charge is from 20 to 30 milliamperes.

A number of these batteries have been in satisfactory use for some months in the wireless section of the Electrical Engineering Dept. of the City and Guilds Engineering College.

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# Notes

### French Railway Experiments.

A committee of experts in France, who have been conducting research with telegraphy on moving trains on the Paris-Orleans line, report that their efforts have met with success. A small portable apparatus was used, and long distance signals were clearly received while the train was moving at full speed.

It is now hoped that with special aerials affixed to the roof of a coach telephony will also be received.

During their experiments members of the committee set up apparatus at some of the stations on the tour and invited farmers and others to listen-in.

### Telephony Reports of Weather Forecasts.

Dr. G. C. Simpson, the director of the Meteorological Office, told the mathematical and physical science section at the British Association meeting that he anticipated that weather forecasts would soon be issued by telephony. A plan of this nature, he said, had already been prepared with details worked out for distributing the "general inference" by wireless telephone as soon as there was an organised scheme for broadcasting in this country. Forecasts would be issued in this way by the Meteorological Office immediately broadcasting was authorised.

### British Association Demonstration.

As previously announced, the Meteorological Office and the Air Ministry provided a demonstration during the meeting of the British Association at Hull. It was shown by weather forecasts that anyone possessing a small receiving set can pick up the messages at the hours fixed by the Air Ministry, Eiffel Tower and other stations.

Although the messages received were in code, it was clearly demonstrated that the code was not secret and was decipherable by any amateur, and that the information could be utilised by all who cared to study the method. (See articles appearing in this journal).

### Concerts by 2 LO.

Permission has been applied for to broadcast wireless concerts from Marconi House on Friday and Saturday, September 22nd and 23rd at the following times: 5—5.30; 6—6.30; 7—7.30 p.m.

These transmissions are dependent upon permission being received from the Postmaster-General. They will be in aid of the Ex-Services Welfare Society's Carnival at Holland Park Hall.

### Dissolution of Partnership.

Mr. J. Griffin and Mr. J. O. Nichol, wireless specialists, trading under the title of the Star Delta Wireless Company, at 333a, Oxford Road, Manchester, have dissolved partnership. Debts will be attended to by Mr. Griffin.

### Anglo-American Service.

Telegraph offices and cable company offices in the United States were opened on September 12th to accept messages for wireless transmission to Great Britain by the service conducted by the Radio Corporation of America and Marconi's Wireless Telegraph Co., Ltd.

### Cost of French Weather Warning Stations.

Weather forecasts sent out by the National Meteorological Office of France for the benefit of agriculturists are received on sets installed at parish schools or gendarmerie stations at a cost of 200f. (£4). Weather warnings are given locally by sounding a bell.

### Stolen Apparatus.

At Penge Police Court, William Thomas Hinton and James Watts were each sentenced to two months' imprisonment with hard labour for being concerned together in stealing from a railway truck at the goods depot at Penge Railway Station a wireless receiving set valued at £4 10s.

### Coming Exhibition at Manchester.

Space is now being booked for a Wireless Exhibition to be held at the City Exhibition Hall, Manchester, in the last week of April.

*The Fire resulting from the recent attack on* **MFT.**

### Clifden.

The accompanying photograph is a snapshot taken by Mr. A. J. May at the wireless station at Clifden, Ireland, and illustrates the burning of a part of the station during recent fighting in that district. The damage done to the station was referred to in our issue of August 5th, page 594,

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**Broadcasting Progress.**

On Tuesday, September 12th, a meeting took place in London between the Committee of the proposed Broadcasting Company and certain officials of the General Post Office. As a result of this meeting it is understood that an official statement on the subject of broadcasting may be expected from the Postmaster-General very shortly.

**Experimental Station Design: A Correction.**

In Fig. 6(*b*), p. 794, the positive and negative connections of the H.T. battery have been shown reversed. The H.T. positive should, of course, go to the plates of the valves.

**Edinburgh Society's New Station.**

Edinburgh and District Radio Society's new transmitting station has the call sign **2TF** and not **2FT** as previously stated.

**Elementary School Set at Southampton.**

At the celebration of the coming of age of the Winnington Road School, Southampton, the formal inauguration of a wireless receiving apparatus took place.

**Lost Postal Packets.**

The Secretary of the Wireless Press, Ltd., having been advised that the mail intended for his company has been tampered with, he would be glad if any of our readers who have sent communications to the Company and who have not received replies, would forward, addressed to him, full particulars of such communications.

**La Fayette.**

At the new station to be opened at La Fayette, Bordeaux, the Société Française Radio-Electrique is to carry out the work of equipment. The type of apparatus will be the same as for Sainte Assise.

**The West London Wireless and Experimental Association.**

Mr. Horace W. Cotton, Hon. Sec., 19, Bushey Road, Harlington, Middlesex, has issued a special notice as follows:—On and after Friday evening September 22nd, 1922, and every subsequent Friday, the meetings of this Association will be held at its new headquarters at Stamford Brook Lodge, Ravenscourt Park, W.6 (close to Stamford Brook Station, District Railway), from 7 to 10 p.m.

**Re-charging of Batteries.**

In order to meet the requirements of suburban and other users of "Hart" portable batteries in London, the Hart Accumulator Co., Ltd., of Marshgate Lane, Stratford, intend inaugurating a motor service for re-charging. For a few shillings monthly, we are told, they would send regularly to various districts in and around London, and collect batteries, and promptly re-deliver them in a fully charged condition, ready for use. The scheme will mature if sufficient users take advantage of it. When communicating with the Hart Accumulator Company the voltage and capacity of the battery in question and the approximate number of times per annum the battery would be required to be recharged should be mentioned, and the letter marked "For Wireless Department."

# Calendar of Current Events

**Friday, September 22nd.**

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.

Lecture on "Construction of Society's Apparatus," by Mr. S. Burman.

WAKEFIELD AND DISTRICT WIRELESS SOCIETY.

Lecture by Mr. H. E. H. Burbury.

LEEDS AND DISTRICT AMATEUR WIRELESS.

At 8 p.m. Second Annual General Meeting.

**Sunday, September 24th.**

*Daily Mail* Concert from the Hague **PCGG** 8 to 9 p.m. B.S.T., on 1,085 metres.

**Monday, September 25th.**

IPSWICH AND DISTRICT WIRELESS SOCIETY.

Sale and exchange of apparatus at 55, Fonnereau Road, Ipswich.

ILKLEY AND DISTRICT RADIO SOCIETY.

At 8 p.m., at Regent Café. Morse practice.

**Tuesday, September 26th.**

Transmission of Telephony at 8 p.m. on 400 metres by **2MT** Writtle.

**Wednesday, September 27th.**

REDHILL AND DISTRICT Y.M.C.A. WIRELESS SOCIETY.

At 111, Station Road, Redhill. Lecture on "Phones and Loud Speakers," by Mr. White.

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION.

A special lecture by Mr. Gall.

**Thursday, September 28th.**

*Daily Mail* Concert from the Hague **PCGG**, 8 to 9 p.m. B.S.T., on 1,085 metres.

RADIO EXPERIMENTAL ASSOCIATION. NOTTINGHAM AND DISTRICT.

Meeting at Room 74, Mechanics' Institute. Discussion on Mr. Ford's lecture on "Radio Measurements." Subscriptions due.

**Friday, September 29th.**

WIRELESS SOCIETY OF HIGHGATE.

At Highgate Literary and Scientific Institute, South Grove, Highgate, N.6. Annual General Meeting, Election of Officers, Annual Report, etc.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.

Lecture on "Oscillatory Circuits," by Mr. A. G. Warren, M.Sc.

**Sunday, October 1st.**

*Daily Mail* concert as above.

**Monday, October 2nd.**

ILKLEY AND DISTRICT WIRELESS SOCIETY.

At 8 p.m. at Regent Café. Morse practice.

**Tuesday, October 3rd.**

Telephony by **2MT** Writtle, as above.

GREENWICH WIRELESS SOCIETY.

At 7.45 p.m. At Rangers House, Blackheath. Ordinary Meeting.

**Wednesday, October 4th.**

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION.

Lecture on "Portable Receivers," by Mr. Donkin.

**Thursday, October 5th.**

*Daily Mail* concert as above.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### West London Wireless and Experimental Association.*

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

A meeting was held on August 31st. Buzzer practice was attended by a good number. Owing to several members still being on their annual holidays nothing exceptional was arranged for. "Listening in" on club's apparatus and an informal chat took place; many questions as to the restriction in connection with the use of reaction circuits were asked, and a question in form of a resolution was sent to the Wireless Society of London in connection therewith. A good attendance was made.

On September 7th another meeting was held. The Morse practice class was well attended. Mr. J. F. Bruce related his experiences in connection with the Armstrong circuit and loop aerial, and much information was given to the members present in connection therewith.

Members are asked to turn up strongly in future and to watch for forthcoming events. It is hoped to have many lecturers from the Wireless Society of London down during the winter session. The Secretary will have much pleasure in replying to any inquirers as to membership, etc.

Club rooms, Belmont Road, Chiswick, W.4.

### The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

On Thursday, August 10th, Mr. Smith kindly read the Society a paper entitled "Useful Wireless Data."

The paper was most instructive and entertaining. A hearty vote of thanks to Mr. Smith was passed on the termination of his lecture.

On Saturday, the 19th, experiments were conducted at Irby Hill, with a two-valve receiver. Excellent results were obtained.

The Society's thanks are due to Mrs. Dodd, who kindly lent the field in which the experiments were made.

Members are requested to note that owing to the Hague concerts, the meeting night has been altered to Wednesday, starting at 7.30 p.m.

### Smethwick Wireless Society.*

Hon. Secretary, Mr. Ralph H. Parker, F.G.S., Radio House, Wilson Road, Smethwick, Staffs.

A meeting was held on Friday, August 11th, Mr. J. Stoney, B.Sc., A.M.I.M.E., in the chair. After the usual buzzer practice the meeting was left open for discussion; it was also arranged that some of the senior members should give short and concise lectures bearing on the elementary principles of wireless for the benefit of a large number of new members.

Mr. C. Grew gave a short discussion on aerials on Friday, August 18th, which was very much appreciated.

A lecture entitled "That Little More Per Cent. Efficiency" was given on September 2nd, by Mr. McKerle. After a vote of thanks had been passed, Mr. Headley, of the Birmingham Club, gave some of his experiences of transmission and reception at Baggeridge Colliery at particular distances underground. A hearty vote of thanks was accorded to Mr. Headley who reciprocated.

### Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

A general meeting was held at the Leeds University on Friday, September 8th. Mr. A. M. Bage (Vice-President) taking the chair at 8.0 p.m. The Chairman called upon Mr. H. Mortimer, of the P.O. Telephones (Leeds) to deliver a paper on "Automatic Telephony." Mr. Mortimer successfully conveyed to the meeting the principle upon which the complicated mechanism installed at the Leeds Exchange functioned. The lecturer briefly outlined the historical facts relating to his subject, and paid special attention to the work of Keith. The principles upon which the old hand-operated exchange worked were considered, in order that one could appreciate fully the great advantages attached to automatic operation. With the aid of lantern slides and the apparatus on view, the methods of automatic operation were explained and made clear to the meeting. The circuits were traced from a subscriber to the exchange by the open and underground wires. It is intended to substitute underground wires or cables for all overhead or open wires. The circuit in the exchange is completed by various apparatus, including the line switch, junctions, the selector switch, etc., and on to the called subscriber by underground and open wires. Most of the switches used seemed extremely delicate devices, being a combination of electrical and mechanical operations. The method of working public telephones was considered, and the means of rectifying faults treated. The lecture concluded with numerous lantern slides showing views of the Leeds Exchange.

The Chairman then opened a discussion, which undoubtedly resulted in the membership acquiring a much greater respect for the P.O. telephone than had hitherto been the case. Numerous practical and theoretical questions were ably dealt with by the lecturer. At the close of the discussion, a hearty vote of thanks was accorded to Mr. Mortimer, for his kindness and for the trouble he had been to in arranging so instructive and fascinating a paper.

The meeting then adjourned.

The second annual general meeting (for members only) will be held on Friday, September 22nd, at

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8.0 p.m. Meetings next session will probably be held weekly, formal (general) and informal (instructional) meetings being held alternately. The Hon. Secretary is drawing up a syllabus of lectures, demonstrations, etc., for the approaching session, 1922-23, and will be pleased to hear from members of local societies, who would lecture before this Society. Intending members should apply to the Hon. Secretary.

### The East London Radio Society.*

Hon. Secretary, Mr. L. E. Lubbock, King George's Hall, East India Dock Road, Poplar.

At a meeting held on Tuesday, September 5th, at the Lecture Hall, Woodstock Road, E.14, the matter of changing the Society's meeting night was discussed at length.

This Society is a large one. It is becoming larger every week and all the members are keen to attend regularly. So much so that it was difficult to find any one night to satisfy everyone. After a considerable amount of discussion it was unanimously decided that it would be absolutely necessary, in view of the increasing membership, to have the Society's accommodation and apparatus at the disposal of the members for at least two evenings every week; these to be Tuesday and Friday.

The first Tuesday in every month being Committee night, the Management Committee then adjourned to their own room, leaving the rest of the members, with the Society's four-valve set, listening in.

The Management Committee arranged the programme for the next month, reserving Tuesdays for lectures and debate, and Fridays for experimental work.

The new arrangement of meeting nights promises well, for on Friday, September 8th, even more members attended than on the previous Tuesday.

The meeting was opened with the usual buzzer practice, after which the Society's sets were put into operation and the members spent the rest of the evening in open discussion. A very pleasant evening ended at 10.15 p.m. with a hearty vote of thanks to the Chairman.

### Wakefield and District Wireless Society.*

Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Wakefield.

A meeting of the above was held in the Physics Laboratory of the Grammar School, at 8.0 p.m. on Friday, September 8th, Mr. Wrigley in the chair. The minutes were read, after which Mr. G. E. Welch was called upon to deliver his lecture on "Simple Facts and Experiments in Electricity."

For upwards of an hour Mr. Welch described the composition of batteries of various kinds, building of an ammeter, voltmeter, measurement of voltage and resistance, electro-magnetism, etc., together with apparatus and blackboard illustrations.

The Chairman moved a vote of thanks for his kindness in making the meeting such a success. Mr. Haig seconded, and the vote was passed very heartily.

The members are looking forward to Mr. H. E. H. Burbury's lecture on the 22nd, probably at the Y.M.C.A., Grove Road, to which intending members are cordially invited.

### Wireless and Experimental Association.*

Hon. Secretary, Mr. Geo. Sutton, 18, Melford Road, S.E. 22.

At the meeting of the Association at the Central Hall, Peckham, on Wednesday, September 6th, Mr. Voigt, fresh from his holidays, detailed the various experiments which he had carried out with the Postmaster-General's permission on a portable receiving set at the hotel where he stayed.

From above the roof to the metal pipes below the cellar floor and every inch in between he carried out his researches, and even did not cease experimenting in the railway carriage which conveyed him home, and, as one might expect, some of the results he got were worthy of note.

His fellow members shared his successes with him on Wednesday, his failures they sympathised with, and few did not add to their sum of wireless knowledge as the result.

The Association went into committee to consider what should be done to meet the vague threats on their liberties, and the Secretary was instructed to write to the Postmaster-General to seek light upon their present and future position. A letter was written and sent to the Secretary, Wireless Section, G.P.O., on the subject of prohibition of the use of amateur constructed receiving apparatus. The letter offered the suggestion that all members of a properly organised and affiliated Wireless Society may be decent *bona-fide* experimenters, and stated that the Association's committee would do all in its power to assist in "keeping order in the ether."

### Ilkley and District Wireless Society.

Hon. Secretary, Mr. E. Stanley Dobson, "Lorne House," Richmond Place, Ilkley.

The Fourth General Meeting of the Society was held at the premises of Mr. Francis Law, Tower Buildings, Ilkley, on September 11th. The chair was taken by the President, Dr. J. B. Whitfield. Following the reading of the minutes of the previous meeting a resolution was passed, deciding on the construction of a receiving set for the society. A committee was appointed to draw up a scheme and prepare estimates to be brought before the next general meeting.

The Chairman then called on Mr. Law to give his lecture on "The Theory, Use and Maintainance of Accumulators." The lecturer commenced by showing the difference between primary and secondary cells and demonstrated the principle of the accumulator in its simplest form by means of "Planté's Electrolysis experiment." The development of this was then traced up to the storage cell as used in practice at the present day. The different makes of cell were explained in turn, the construction of the plates being dealt with in detail. Mr. Law then proceeded to give some very useful hints on the care of cells. The allowable rates for charge and discharge were dealt with, with particular regard to the needs of the wireless amateur using one or more valves. Instructions for charging cells at home, where necessary supply of current is available were given, and the causes of sulphating and buckling were explained, together with the appropriate remedies where such are possible.

At the close of the lecture a hearty vote of thanks was accorded to Mr. Law, and an interesting discussion followed.

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### Belvedere and District Radio and Scientific Society.

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

A successful meeting of the above society was held on Friday, September 8th, at the Erith Technical Institute, for the purpose of enrolling members, a preliminary meeting having been held in July. The President (F. J. Watson, Esq.) was in the chair.

The programme of weekly meetings for the month of September was arranged. Lectures were to be given by Mr. A. G. Warren, M.Sc., M.I.E.E., F. Inst. P., on "Scope of Wireless" and "Oscillatory Circuits." Mr. S. Burman will commence a series of lectures on "The Construction of the Society's Apparatus."

The Secretary was instructed to apply for affiliation to the Wireless Society of London.

There were 47 members enrolled and it is hoped that this number in the near future will be considerably increased.

The Secretary will be pleased to give full information to amateurs living in Erith, Belvedere and district.

### Fulham and Chelsea Amateur Radio and Social Society.

Secretary, Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W.6.

A general meeting of the above Society was held at their temporary headquarters at the Social Centre, Townmead Road, Fulham, attendance for the evening being 45 and new members enrolled numbered 8.

The crystal set was fully discussed by the members, and numerous question papers were handed in. The majority being dealt with by the Secretary.

Ladies are specially invited to join the above Society. Full particulars may be obtained from the Secretary.

### The Fulham and Putney Radio Society.

Hon. Secretary, Mr. J. Wright Dewhurst, 52, North End Road, West Kensington, London, W.14.

The above Society started the autumn season with a meeting at their new headquarters on Friday, September 8th. The new headquarters is a large studio centrally situated, and has a large aerial fitted, and has been kindly lent by Mr. E. Vernon Barker, M.P.P.A.

As a prologue to the meeting Mr. Barker switched on his set and the members heard the result of the air race through a Brown loud speaker.

A considerable amount of business was done at the meeting, a new committee was formed to deal with the rules, etc. By a vote of the members it was found that Friday evening was a more suitable night for the meetings, and so the future meetings will be held on that night. A large number of new members were enrolled with promises of more to follow. It was decided that the first Friday in each month should be set apart for lectures and it is hoped to start with a well-known lecturer on the October meeting, the between meetings to be devoted to Morse buzzer practice and minor demonstrations and discussions.

At the conclusion of the business Mr. E. Vernon Barker, who is a member of this and the Willesden Society, explained his apparatus to the members, and with five valves and the Brown loud speaker obtained music and singing that was rendered particularly clear and free from the usual disturbances. Mr. Barker was congratulated upon the completeness and arrangement of his apparatus and it was nearly 11 p.m. before the meeting closed.

All amateurs in the district are cordially invited to join the Society, and are assured of a continuance of instructive and entertaining meetings.

The Society has been formed purely as a Wireless Society devoted to the assistance of the amateur and novice in the science of wireless telegraphy and telephony.

### Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road.

The weekly meeting of the above Society was held on Wednesday, September 6th, at Kingsland Assembly Rooms. A fair attendance was recorded. Dr. MacDougall brought his three-valve receiver to the meeting and gave an interesting demonstration, which was thoroughly enjoyed by all present. Mr. Goodall, of Southampton, also gave from his experimental station for the benefit of the Society, a transmision of speech and music. At the conclusion of the meeting a hearty vote of thanks was accorded to Dr. MacDougall and Mr. Goodall. The Society are now organising demonstrations fortnightly, and lectures by well-known people, and a pleasant time should be in store for the coming winter. All particulars, etc., can be obtained from the Hon. Secretary.

### Portsmouth and District Wireless Association.

Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

On Wednesday, September 6th, the usual monthly meeting was held at the Pile Memorial Rooms, Fratton Road. A large number were present and four new members were elected. In view of an anticipated large increase in membership, a Vice-President was also proposed, Mr. Stevenson being unanimously elected to fill the post.

In future it has been decided to hold two business meetings each month, the first and third Wednesdays suiting the majority of the members.

A visit was recently made to the local electric light and power station. This visit was arranged by Mr. Lawrence, a station engineer, and a most enjoyable afternoon was spent by all those present.

Forthcoming lectures include the following:—September 27th, a special lecture by Mr. Gall. October 4th, "Portable Receivers," by Mr. Donkin. October 11th, "Charging Accumulators by the Noden Valve off A.C. Mains," by Mr. R. Cole.

### Barnes, Mortlake and Richmond District Wireless Society.

Hon. Secretary, Mr. Eric A. Rogers, 122, Wood Street, E.C.2.

The first meeting of the above was arranged to be held at Inglenook, Sheen Gate Gardens, East Sheen, on Wednesday, September 20th, by kind invitation of Mr. and Mrs. Davy.

Mr. Blake has kindly accepted the office of President of the above. The Society's future and its rules were discussed.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:*—(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, 12/,13 *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents.* (6) *Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of* 1*s., or* 3*s.* 6*d. for a maximum of four questions.* (7) *Four questions is the maximum which may be sent in at one time.*

*In view of the serious interference which an oscillating receiver can cause to other receivers in its neighbourhood, it is understood that for broadcast wavelengths, certainly, and possibly for all wavelengths, the Postmaster-General will in future allow no type of circuit which is capable of oscillating and so energising the aerial, either directly or through any circuit coupled to it.*

*The necessary consequence of this restriction is that if reaction of the type commonly used in the past is still employed, it must be in such a way that the oscillation point cannot be reached over the wavelength range of the receiver, however tightly the reaction coil is coupled, and with whatever values of filament voltage or plate voltage the set is worked.*

*In order to comply with this requiremenent, it is essential that the reaction coil should be sufficiently loosely coupled to the aerial inductances as not to set up oscillations or alternatively the reaction might be arranged between the grid and plate circuits of a high frequency amplifier as shown on p.* 715 *of the issue of September 2nd.*

*We strongly urge readers who are making or using sets of the usual reacting type to either reduce the amount of reaction which they can employ to such an extent that they are perfectly satisfied that the set can never oscillate or to cut out their reaction entirely.*

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**"E.P." (Bexley Heath).**—(1 and 2) See various answers which have appeared in the last few issues to queries on this point. (3) 45 plates for 0·0005 mfds. Numbers for other capacities in proportion.

**"F.M." (Sydenham)** *asks re the Armstrong super-regenerative circuit.* (1) *If crystal rectification is possible instead of one of the valves in this circuit.* (2) *What are the merits of potentiometer grid control.* (3) *If it is possible to determine the hardness of a valve by judging the type of discharge with a spark coil put across the plate and filament.*

(1) Not possible, as is evident from the whole principle of the circuit. (2) Potentiometer control enables the adjustment of the working point to the best part of the valve characteristic more accurately than can be done by a fixed connection. (3) A hard valve in anything like condition is too hard to give results in this way—moreover, if obtained, the results would be seriously detrimental to the valve.

**"INKY" (Newbury).**—The amplifier may be as in Fig. 1, to be introduced instead of the telephones of your set, but why specify separate batteries which are wasteful and in no way improve results.

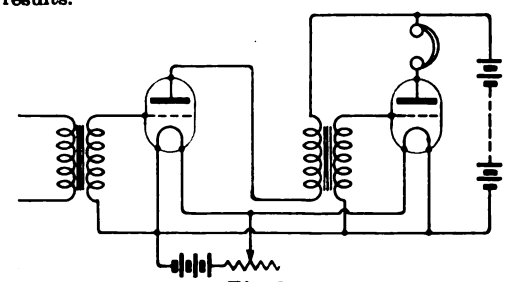

*Fig.* 1.

**"W.E.R." (Histon)** *gives a diagram of a circuit which he wishes to adapt for short wavelengths and asks* (1) *For various windings and suitable capacities.* (2) *If using* 4,000 *or* 8,000 *ohm telephones in place of* 2,000 *ohm. would appreciably increase signal strength.*

(1) For remarks on circuits of this type see note at the head of these columns. Parallel A.T.C. is worse than useless at short waves. L.1 might have 120 turns with a mean diameter of 2″. L.2, 100 turns with a similar diameter. L.3 is best omitted. Suitable condenser values have been given repeatedly. (2) You might expect 15% to 25% improvement.

**"M.N." (Prague)** *asks* (1) *The meaning of the abbreviation "O.K."* (2) *Actual sizes of certain gauges of wire.* (3) *Which of two possible sizes of wire to use in place of the one suggested.* (4) *What is the shortest wavelength on which a capacity resistance receiver is efficient.*

(1) A phonetic abbreviation for "all correct." (2) See below. No. 10 = 3·25 mm., 12 = 2·64 mm., 14 = 2·03 mm. 16 = 1·63 mm., 18 = 1·22 mm., 24 = 0·56 mm., 32 = 0·27 mm., 34 = 0·23 mm., 38 = 0·15 mm., 42 = 0·10 mm., 44 = 0·081mm., 46 = 0·061 mm., 47 = 0·051 mm. (3) We should prefer the thicker wire unless it is absolutely necessary to get the full range in which case the thinner wire should be used. (4) About 1,000 metres, but there is no definite or sharp limit.



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**"JUMPER" (Woking)** *asks* (1) *If a reactance condenser could be used instead of a reactance coil in the H.F. amplifier and detector circuit described in the issue of July 22nd, and if so, the capacity.* (2) *If telephone lines running at right angles about 10 ft. below his aerial affect its working.*

(1) Yes, except for the limitations imposed by the P.M.G. on both these types of reaction. We are afraid we cannot state a "safe" value for the capacity required without experiment. (2) Probably not.

**"G.W.D." (Durham)** *asks for a diagram for a three-valve receiver.* (2) *Size of former and wire for reaction coil for use with this set.*

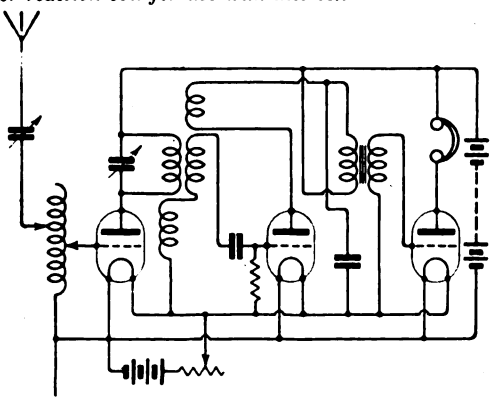

*Fig. 2.*

(1) See diagram (Fig. 2). (2) See note at the head of these columns on the subject of reaction, but with circuit given 4" × 3" of No. 26 should be all right provided that there is no coupling between the A.T.I. and the remaining coils.

**"W.R.G." (Tiverton)** *has a certain make of telephone transformer and asks how same is connected up, and why there are only three connections.*

From the information you give there appears to be a H.R. winding across *P* and *P'*−, and a L.R. winding across the telephone terminals. Cross-connecting one side of each winding in the manner shown in fairly common practice—connections for each circuit should, of course, be made to the black lead. We cannot say whether a condenser is incorporated—probably not.

**"W.R.S." (Burgess Hill).**—(1) *A.*—0·005 mfds. *B.*—0·002 mfds. *C.*—0·002 mfds. *D.*—0·001 mfds. (2) Yes. (3) 2 megohms. (4) No. For comments on reaction sets of this type, see note at the head of columns.

**"LUCK" (Grimsby)** *asks* (1) *The resistance of a single telephone receiver wound full of wire of which he encloses sample.* (2) *Where to obtain diaphragms of any size or thickness.*

(1) We are quite unable to say from the information furnished, but it is probably fairly high—say, 1,000/2,000 ohms. (2) You will find it very difficult to obtain diaphragms of *any* size or thickness, but you should be able to get common sizes from dealers in accessories, or from telephone makers, who might possibly agree to cut you special sizes.

**"GRID MODULATION" (Liverpool)** *asks* (1) *With regard to a modulated grid circuit if it is necessary for both grid and plate circuit to be tuned.* (2) *With reference to a microphone transformer, page 132, in May 28th issue, if this transformer would be more efficient if enamelled wire were used for the secondary.* (3) *With reference to Fig. 6, page 131, May 28th issue, what is the value of the by-pass condenser C.*

(1) In a grid modulated oscillator it is not in general necessary to tune the grid circuit as well as the plate, although in some cases it is desirable to do so. The best value of the grid coil for each case should be determined by experiment. (2) There is very little difference in efficiency, but enamelled wire needs rather more careful handling. About 3 ozs. should be sufficient. (3) About 0·001 mfds.

**"....." (Kingston-on-Thames)** *asks* (1) *Reason for a sudden falling off and then increase in signal strength when receiving Leafield with a 6-volt accumulator which had run down.* (2) *If atmospherics would be of equal strength at two receiving stations with aerials of different heights.*

(1) It is not possible to give an absolute reason without careful experiment, but it is probably due to the drop in filament voltage lowering the position of the upper bend of the charactoristic and bringing it back to the point of grid potential on which the valve was operating. (2) We cannot give a hard and fast rule, but in general the atmospherics should be somewhat less troublesome with the lower aerial.

**"C.G." (London)** *sends some information about a tuner and asks* (1) *Wavelength it is suitable for.* (2) *If it can be used for crystal and valve.* (3) *If it is used in conjunction with the Armstrong super-regenerative circuit, whether music will be audible all over a room without a loud speaker.*

(1) The information supplied is insufficient for us to identify the instrument or to state range, but from particulars given it would appear quite unsuitable in its present form for a two-circuit tuner. You might rewind secondary with about 250 turns, using pile winding. The instrument should then be suitable for about 2,000 metres. (2) In its present form it might be used for A.T.I. and reaction, but this arrangement is not to be allowed in future owing to the possibility of re-radiation. (3) This depends very much on the rest of the apparatus employed, but probably not.

**"J.C.B." (Cricklewood).**—(1) and (3) You do not give us enough information to help you much. The components appear O.K., but as you give no diagram we cannot say whether your circuit is efficient. Try removing the reaction coil, which will not in future be allowed. (2) Yes. Put the H.R. telephones in series with the H.R. winding of the telephone transformer, which should be used with the L.R. telephones.

**"A.C.McA." (Birmingham)** *asks* (1) *How many honeycomb coils, with how many turns, should be used to tune to* 10,000 *metres with a* 0·0015 *condenser, the former being* 2" × ½". (2) *If it would injure the coils to soak them in shellac varnish.*

(1) Assuming 2" to be the diameter of the former, about six coils, with numbers of turns ranging from 25/400, should be provided. (2) The coils may be

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dipped in thin shellac varnish if carefully dried afterwards, but they must not be left damp, or covered with an unnecessarily large amount of shellac.

**"C.J." (Leeds)** *asks the following questions about the Armstrong super-regenerative circuit.* (1) *Voltage of the various batteries.* (2) *If one battery can be used for the three filaments.* (3) *Data for the oscillation circuits.* (4) *Number of turns for a set of coils to cover all purposes on tuner and receiver. N.B.—As this circuit may radiate seriously when out of adjustment, it is almost certain to be prohibited by the P.M.G.*

(1) Grid batteries may be dry cells, up to 12 volts. Plate and filament volts should have normal values for the type of valve used. (2) Yes. (3) Values suitable for about 5,000 metres, say 0·002 mfds. and 3,000 mhys. A two-coil holder might be used. (4) The tuner is only suitable for short waves. The tuner coils might be 80 turns, and the oscillator coils 300.

**"H.O.W." (Thames Ditton).**—See diagram (Fig. 3) for the set required. The telephones should be H.R., and any recognised brand of hard valve may be used.

(4) *If it would affect reception if the reaction and A.T.I. leads were carried by four-wire flex, and also if the L.F. transformer leads were carried in the same way.*

(1) Special valves for this purpose, with very excellent performance, are being got out by the leading manufacturers, of whom you should make enquiries. We are obviously unable to single out any one valve in particular for favourable comment. (2) It depends on the type of valve and circuit. For a single valve circuit with a normal receiving valve, 1,000/2,000 ohms per volt would be needed. (3) Not usually necessary, but its use can do no harm. It should be of iron. (4) Yes. You would probably get serious howling trouble, particularly in the H.F. case.

**"C.W.E." (Streatham)** *submits a two-valve circuit and asks* (1) *For windings for* 3,000 *metres.* (2) *If the reaction coil and A.T.I. are inductively coupled in any way.*

(1) A.T.I. might be 9" × 6" of No. 22. As you have no other method of tuning, provision of taps would not be sufficient. A slider would be necessary. Reaction of the type suggested is to be prohibited in future by the P.M.G. Your set

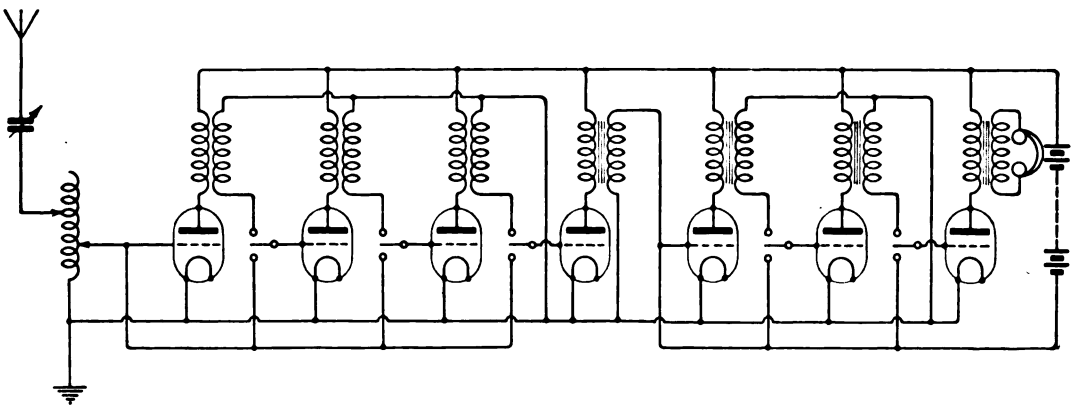

*Fig.* 3.

**"S.F.H." (Barnes)** *asks* (1) *Whether a separate heterodyne could be used with various types of crystal and valve sets.* (2) *For a diagram of a set to fulfil certain requirements.* (3) *Thickness of copper foil and what size* 10 *m/m mica must be to make a fixed condenser of* 0·002 *mfds.* (4) *Price of Berne List.*

(1) A separate heterodyne might be used with any type of receiver. (2) Your statements are very vague. We presume you require a range of 300 metres upwards, instead of downwards as suggested. Type of circuit to employ will depend on range required, *i.e.*, for broadcasting, a crystal set will do up to 20 miles, one valve 35 miles, two valves 50/60 miles, and so on. Circuits of each type have been repeatedly given. (3) 8 square cms. of overlap for the foils will be required. The thickness of the copper foil is immaterial. (4) About 20s. Amendments are published monthly.

**"C.L." (Malvern)** *asks* (1) *The best valve for L.F. amplification.* (2) *How much resistance to use to vary the plate voltage of a non-tapped H.T. battery.* (3) *If the L.F. transformer of a L.F. amplifier should be surrounded by an earth plate.* should therefore be much more efficient if arranged as in Fig. 5, page 573, July 28th issue. (2) In your circuit the A.T.I. and reaction coil should certainly be inductively coupled together, but see note above.

**"J.B." (Gt. Yarmouth).**—(1) The sets submitted only differ in minor points, and there should be very little difference in their respective performances. (2) You might get various British broadcasting stations on a three-valve set if your aerial were increased in height and length, but seeing that the use of reaction is to be so much restricted, the results obtained are not likely to be very good. (3) A 6′ length of ⅛″ diameter brass tubing would make a fairly good earth if buried vertically in damp soil. (4) Additional L.F. amplification would be necessary for the use of a loud speaker.

**"VERY INNOCENT" (London).**—(1) The maximum wavelength with your aerial would probably be about 2,000 metres. Minimum 350 metres. This wavelength could be somewhat increased by adding a coil in series with the aerial.

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**"W.B." (Bradford)** *sends diagram of a set and asks* (1) *For comments.* (2) *What arrangement of valves to use with it.* (3) *The reason for a particular tuning effect.* (4) *How to get* 200 *metres wavelength with basket coils.*

(1) The diagram sent is rather staggering. Your aerial is shown connected directly to earth, with the A.T.I. introduced somewhere in the grid lead. One side of your reaction coil is connected to the grid of the first valve, and the other side to nothing, and the remainder of your anode connections are wrong. We should advise you to consult carefully the many three-valve diagrams which have been given recently. (2) Probably best to use the "Ora" for the first valve, followed by the two "R" valves. (3) This is probably due to the set starting to oscillate, and the signals are improved gradually up to this point, and are then completely lost. For 200 metres the A.T.I. might have 50 turns with a mean diameter of 2½", with a series aerial condenser.

**"S.G.O." (Birmingham)** *asks* (1) *The probable wavelength of the proposed English broadcasting stations.* (2) *For a diagram of a set to fulfil certain requirements.* (3) *Maximum length of aerial allowed by the P.M.G.*

(1) Various values between 350 and 425 metres. (2) See diagram (Fig. 4). The loud speaker and various numbers of telephones may be introduced as desired in a position in which a pair of telephones is shown. (3) 100 ft.

**"J.McV." (Belfast)** *asks* (1) *For a diagram of a set suitable for the reception of* **PCGG** *and English concerts in Belfast.* (2) *If we advise replacing resistance capacity amplification with transformer coupling for short wave work, and also putting the A.T.C. in series.* (3) *If we recommend the new Armstrong circuit for use in his position.* (4) *Whether a certain aerial would be O.K.*

(1) See diagram given to **"S.G.O." (Birmingham)** above. (2) Yes, in both instances. (3) The set is capable of good results, but needs very careful and skilful attention. (4) Fairly good, but more than 20′ of height is desirable.

**"W.E.R." (Holloway).**—(1) The tuner suggested would be quite satisfactory. (2) The above circuit is quite suitable for all wavelengths with interchangeable coils, the variable condensers used having capacities of about 0·005 mfds. for short wavelengths, and somewhat higher values for long waves. (3) There is no danger of burning out telephones on a five-valve amplifier unless excessive plate voltages are used. The average plate current passing through the last valve of a multi-valve amplifier is very little different from that passing through the first valve, and is generally of the order of a milliamp. (4) Either a change-over switch or the jacks may be used.

**"R.Y.H." (Monkokehampton).**—The probable reason for your oscillation trouble is running your grid and plate leads too closely together. You may be able to stop it by applying a little positive potential to the grid of the first valve; also, the H.T. lead from the first anode should go to the positive of the H.T. battery and not the position shown. (2) It is quite possible that you may have difficulty in getting **2MT** at such a distance, unless your set is in the best possible adjustment, particularly as you are using a comparatively large A.T.C. (3) From the information given we cannot say what is the matter with your telephones, which have apparently developed some fault. We should advise returning them to the makers for overhaul. (4) This circuit is O.K. except for points commented on with your previous circuit.

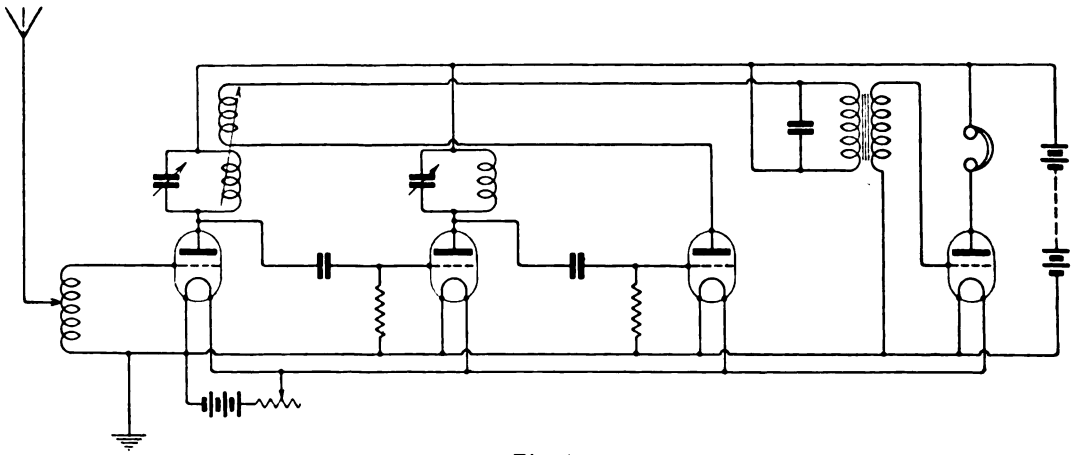

*Fig.* 4.

**"A.N.H." (Edinburgh)** *gets poor results with an aerial which is led in down a chimney, and asks for comments.*

The running of a lead close to brickwork is never satisfactory, and is probably worse than usual when the brickwork is covered with soot. You do not say whether the chimney is used for its normal purpose. If so, the bad results are probably due to a deposit of soot on the glass insulating tube. You do not describe the insulation at the bottom of the tube, which is also possibly affected. Possibly, also, your earth is not as good as it might be.

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**"AMATEUR" (New Barnet).**—(1) The wavelength range would depend on the circuit used as well as the wire with which the A.T.I. is used. Best results would be obtained with condenser in series and the A.T.I. wound with No. 24. Maximum wavelength would then be about 1,000 metres with a normal aerial. (2) For receiving up to 9,000 metres, basket or honeycomb coils are more convenient in size than solenoids, and their performance is satisfactory electrically. (3) The cable submitted might be used for aerial and earth connections, but is too stiff for other purposes.

**"C.M.M." (Stockwell)** *asks* (1) *The gauges of three samples of wire.* (2) *Which is the most suitable for winding H.F. transformers.* (3) *Whether beechwood, boiled in paraffin wax, would be an efficient material for a H.F. transformer and, if not, for a good ebonite substitute.* (4) *How many transformers of the type indicated would be required to cover a range of* 150/2,000 *metres when used with a variable condenser.*

(1) A = No. 26. B = No. 34. C = No. 41. (2) No. 41. (3) Not very good. Millboard tubes, dipped in shellac and carefully dried, would be better. (4) Three would be sufficient, or four to allow a good overlap.

**"..... " (Southport).**—(1) Better results are probably obtained because the coils have a less distributed capacity. Signals are generally somewhat stronger on a single circuit than they are with a double circuit. The latter is used because the extra selectivity which is given eliminates much trouble from interference. (2) There is no simple formula. If the coils are not coupled together, their number would be approximate as the square of the wavelength, but owing to the fact that the coils are generally very closely coupled, much less than this is actually needed. (3) The method suggested may quite well be used. (4) See various replies since the issue referred to.

**"T.S." (Sydenham)** *asks for a loose coupler to tune up to* 3,500 *metres.*

Primary might be 9" × 7" of No. 22, preferably with a slider. Secondary may be 7" × 5" of No. 26, with taps at ½", 1", 1½", 2", 4" and 5½". Closed circuit condenser may be 0 0005 mfds. at maximum.

**"J.P." (Spain)** *asks* (1) *If it is possible to receive* FL *telephony at* 800 *kilometres on a frame with a six-valve set, having* 3 *H.F. and* 3 *L.F.* (2) *If so, the size of the frame.*

(1) We should not expect very good results at this distance, but by careful use of reaction you would probably obtain some results. (2) The frame might be 1·5 metres in diameter, and have 25 turns spaced 0·5 cms. apart.

**"W.P.G." (Gloucester)** *sends a description of a set and asks* (1) *If a crystal would improve results.* (2) *If the reactance coil should be of finer wire than the A.T.I.* (3) *For windings for the H.F. transformer.* (4) *If results would be as good if the reaction coil is wound with No.* 24 *wire and the same number of turns as at present.*

(1) It should improve results if connected as in the reply to "D.C.M." (Dublin), July 22nd issue. (2) Not necessarily, but it may be, and it is often convenient to make it so. (3) Try 50 turns of No. 40 for each winding on a former 1¼" diameter with shellaced paper between the windings. (4) No, because the coupling between the coil would be less. *N.B.*—See recent remarks on reaction of this type.

**"M N." (Prague).**—(1) The multi-wire aerial will be the better, but little advantage would be gained by the use of more than two wires. (2) The circuit of your Fig. 3 will be quite O.K. Values should be as follows:—A.T.C., 0·0015 mfds. Closed circuit condenser, 0·001 mfds. Coils—an assortment of honeycomb type, in sizes up to about 1,000 turns with a mean diameter of 2" (3) Scheme 2 would be very inefficient. Either 3 or 4 might be used—preferably 3.

**"CONSTANT READER" (.....)** *asks* (1) *For a two-valve set to conform to certain requirements.* (2) *Capacities of the condensers.* (3) *Best kind of valve to use.*

(1) and (2) See diagram (Fig. 5). (3) Any standard hard valve by a reputable maker would give good results.

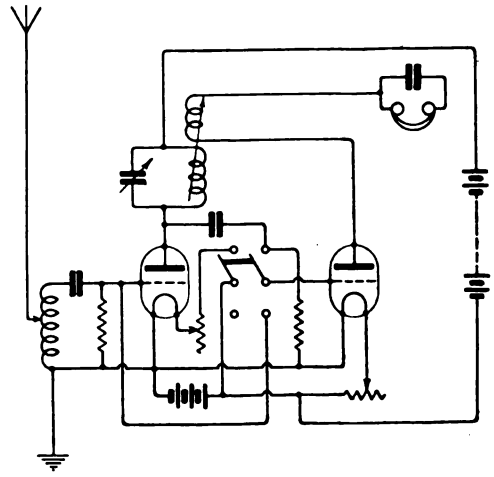

*Fig. 5.*

**"R.B." (Carlisle)** *asks for criticism of a set, and what he may expect to receive on it.*

The set is all right except (1) For short waves A.T.C. should be in series with the A.T.I. (2) The loose coupler should be tuned by a variable coil. (3) The reactance coils should be connected in the anode circuit of the first valve and not in that of the L.F. amplifying valve. (4) Reaction of this type is no longer to be permitted. You might possibly receive broadcasting from Manchester, Newcastle and Glasgow if these points are attended to, and you will also get stations such as Cullercoats and the larger Continental stations, and possibly ships.

**"A.E." (Bournemouth)** *asks for advice with a four-valve set which howls and gives no other results.*

The diagram submitted is quite correct and should give no trouble. Howling is probably due to coupling between the L.F. transformers. This might be cured by altering their position, or by screening them in iron boxes. It may also be due to the grid and plate leads of the H.F. valve being run too close together, remedy for which is obvious.

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**"NOYZ" (Tiverton).**—The circuit shown is quite correct, and the winding up is also as it should be except that all the L.T. battery leads may be run to a common battery. Your arrangements are distinctly ingenious.

**"D.D.W." (Ebbw Vale)** *asks* (1) *For criticism of an amplifier.* (2) *For a circuit to use with it.* (3) *If the telephone terminals are shown in the right place.* (4) *If circuit will operate with valves taking 20/30 volts on the plate.*

(1) Circuit is quite correct except for reaction, which will probably have to be omitted, but if used should be connected as in various recent diagrams. (2) Any simple two-circuit tuner might be used as, for instance, Fig. 1, page 670, August 19th issue, with the addition of a switch for paralleling the A.T.C. and A.T.I. for long wavelengths. For wavelengths up to 20,000 metres both the A.T.C. and the closed circuit condenser might be 0 003 mfds. (3) Yes. (4) Yes, but if so about a 45-volt battery should be used to allow for the drop through the anode resistance.

**"X.Y.Z." (Seaham Harbour)** *asks* (1) *For a circuit to fulfil certain requirements.* (2) *Values of condensers and resistance to use.*

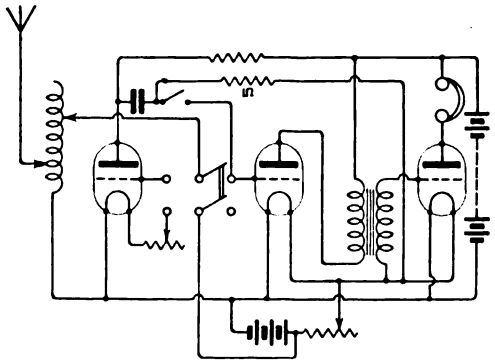

*Fig.* 6.

(1) See diagram (Fig. 6 ). (2) The anode resistance may be 50,000 ohms ; grid leak 1 megohm and coupling condenser 0·002.

**"J.P.N." (Frieborg)** *refers to the article by G. P. Kendall in the issue of June 3rd, and asks under what condition it is possible to use reaction coil for amplification, and not for heterodyne.* (2) *If a frame aerial can usefully be connected to an outdoor aerial.* (3) *Since a certain amount of rectification occurs at each stage of resistance capacity amplifier, if the intervalve condensers should be increased in capacity to pass on the L.F. pulses arising.* (4) *Refers to the article on page 18, April 1st issue, and asks whether the intervalve capacity of 0·003 mfds. there quoted is not too great.*

(1) Conditions on the use of reaction are given in the article referred to. For amplification without heterodyne effect reaction coupling must not be great enough to cause the set to oscillate. This can be assured either by using a very small reaction coil or by preventing too close coupling between it and the tuning coils. (2) Not as a rule, but special directional effects may be obtained by the use of frames in conjunction with external aerials. (3) No, this is undesirable as it introduces less efficiency in the amplification of the H.F. component. (4) In our experience this is excessive except for very long wavelengths.

**"F.W.G." (Finchley)** *sends a sketch of his set and asks* (1) *If the coils are all connected, though only one is inserted for a time, would it result in "dead-end" losses* (2) *What type of reaction would be best with the set.*

(1) Yes, probably of a fairly serious nature, even without the tapping scheme suggested, which is quite hopeless as it permanently connects the coils in a large number of ways. Whenever you switch for a particular connection of a particular coil you will find that you have a variety of sections of other coils in circuit at the same time. (2) Reaction could not be employed without the use of entirely separate coils for the purpose, and see recent notes on the subject. The best method of getting a range of this magnitude is by a set of interchangeable slab coils, not connected in any way.

**"RADIO" (Bournemouth)** *refers to the article on an experimental station in the issue of June 10th, and asks* (1) *If the slab coils could be used as loading coils.* (2) *If No. 28 wire would do.* (3) *If the slab coils could be used with a switch and studs.* (4) *If an aerial 36' high and 48' long is good enough.*

(1) It depends on the wavelength required, about which you say nothing. Some indications are given in the article referred to. (2) Enamelled covered wire is not recommended for this type of coil owing to the risk of the insulation being damaged in winding. (3) Certainly. (4) Quite good.

**"SOLWAY" (Whitehaven)** *sends a sketch of a loose coupler and asks* (1) *For criticism and the maximum wavelength obtainable.* (2) *If a five-valve receiver, with aerial as sketched, will receive* **2 MT, PCGG** *and* **FL.** (3) *If an alternative arrangement of aerial will give better results.* (4) *If any set on the market will receive these stations at Whitehaven.*

(1) A 0·001 mfd. condenser across the A.T.I. is hopeless. None should be used on short waves, and only about 0·001 mfd. on long. Your coupler would be efficient up to about 2,000 metres. (2) **FL** probably, remaining stations very doubtful. (3) This aerial will give you a much better chance. We are doubtful whether this will give good results with the restricted reaction to be allowed in future. (4) We know of no set on which we should care to guarantee the desired results.

**"AMATEUR" (Stoke-on-Trent)** *sends a sketch of his set and asks* (1) *For criticism.* (2) *How to add a third and fourth valve.* (3) *If a certain arrangement of his apparatus will give capacity interference, and if this can be obviated by screening.* (4) *What are the advantages and disadvantages of* (*a*) *plug-in type H.F. transformers or selective switch type ;* (*b*) *A.T.I. basket coil or slider type.*

(1) The circuit is O.K. except that the condenser marked 0·004 mfd. should be replaced by a leak of about 1 megohm. (2) See Fig. 1, page 303, issue for June 3rd. A three-valve set can be built up on exactly similar lines. (3) You may get some capacity troubles. We should advise you to get over them as far as possible by the attention to the exact position of parts and leads rather than by the

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use of screens, which, however, may be some help. (4) (*a*) Performance as a rule is somewhat better for plug-in type. There are no dead-end effects. (*b*) The slider type gives almost continuous adjustment, and is preferable except from the point of view of saving of space.

**"B.B.H." (Eastbourne)** *encloses a diagram of his set and asks* (1) *If he can receive C.W., spark and telephony on it.* (2) *How much and what kind of wire should be used to wind the variometer formers to receive wavelengths of* 300/3,000 *metres.* (3) *Winding details for primary and secondary coils.* (4) *For a diagram of a circuit for two-step amplifier to be added to his set.*

(1) No, we do not like this arrangement at all. The nearest satisfactory approach to it is the American short-wave tuner of June 3rd issue of which it appears to be a poor copy. The grid leak should go from the grid to the filament, not as shown. (2) and (3) This type of construction is unsuitable for such a range of wavelengths, and we cannot give the desired figures. (4) See diagram (Fig. 7) for a possible variation of this type.

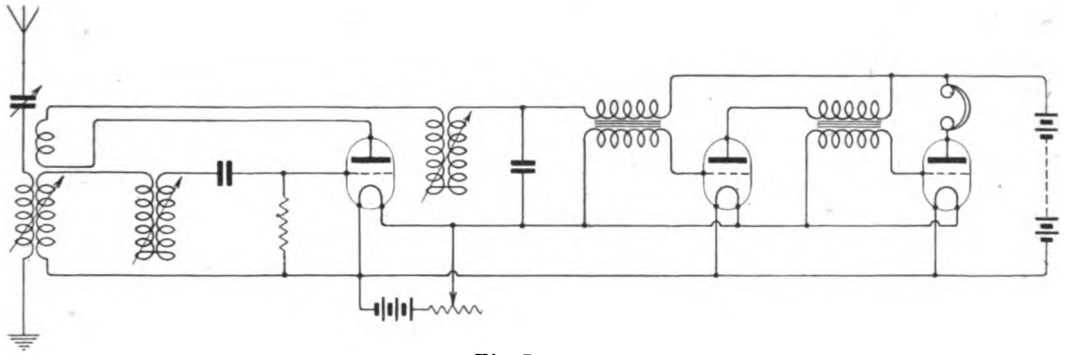

*Fig.* 7.

**"IN DOUBT" (Staines).**—Yes, for a short wave range set.

**"E.T." (Newport).**—(1) The reasons for the poorness of the demonstrations are various. It is possible to obtain perfect articulation by wireless with quite clear signals. In order to get this, the following conditions are essential. (*a*) The proper gear. (*b*) In the hands of someone thoroughly conversant with its use. (*c*) Reception from a distance well within the range of the transmitting station. We suggest that the poorness of the results you heard were due to the failure of (*c*), and faulty adjustment of the gear by the operator. For really good results, musically speaking, we do not recommend the reception of broadcasting stations at more than 100 miles. (2) PCGG very doubtful, 2 MT probably. Paris and Berlin possibly, as these stations use larger power. (3) It is impossible for us to recommend any one of the many advertised sets, but you should use several valves.

**"C.J.W." (Coventry)** *describes his set and asks the maximum and minimum wavelength to which he can tune.*

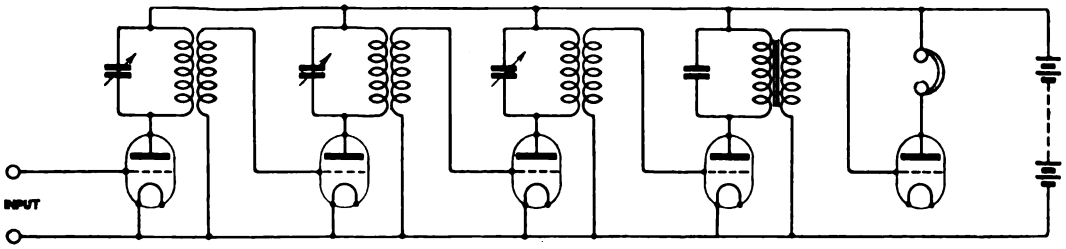


*Fig.* 8.

**"RAGS" (Watford)** *asks for a diagram of a simple type of five-valve amplifier.*

See diagram (Fig. 8), in which we have omitted reaction as this will probably not be allowed for broadcast wavelengths.

**"GEORGIUS" (Crewe)** *asks three questions about his set.*

(1) Arrange as in the circuit given to **"G.B." (Fulham).** (2) Capacity of condenser 0·0006 mfds. Probably the insulation of the glass condenser is in some way defective. (3) Very little, if at all.

Without taps on the secondary your minimum will probably be over 1,000 metres, and maximum 5,000 metres.

**"W.P." (Plumstead)** *asks* (1) *Whether constructional details of a two-valve receiving set, not transformer coupled, have been given in past issues.* (2) *If not published, where such details can be obtained.*

(1) Constructional details of such a set have not been given in a recent issue, but you will find a great deal of information in Alan L. M. Douglas's book, "The Construction of Amateur Valve Stations." A suitable circuit is given on page 12.

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"**H.A.C.**" **(Rotherham)** *encloses a diagram of his set and asks* (1) *For any suggested improvements.* (2) *If the grid circuit should pass through the filament rheostat, or if it may be as shown in diagram.* (3) *If a* 1/5 *Sullivan transformer will be O.K. for this set.* (4) *If a grid potentiometer would improve the set.*

(1) No, the set is quite O.K. We cannot suggest any considerable improvements, although filament switches to cut out the valves not required would be an advantage. (2) The suggested scheme is all right, but will give you a somewhat smaller range of potential. (3) Yes. (4) No, a potentiometer is unnecessary with grid condenser and leak.

"**E.S.**" **(Highbury)** *asks* (1) *If he can use* 152 *ohms telephones with a transformer on a crystal set: also particulars of windings for this transformer, using No.* 25 *and* 36 *S.W.G. enamelled wire.* (2) *For the best type of valve and connections for note magnifier with a crytsal set.*

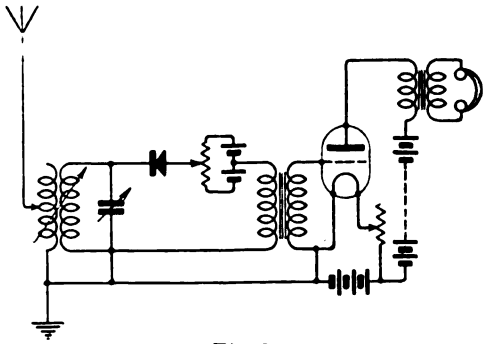

*Fig.* 9.

(1) The wires suggested are quite unsuitable for an efficient transformer of this type, but if used you might try a core of 1" diameter by 6" long, with 9 ozs. of No. 25 and 7 ozs. of No. 36 for the windings. (2) Any hard receiving valve will do. Connections may be as in the diagram (Fig. 9).

"**NEGATRON**" **(Coventry)** *asks* (1) *Why a certain receiver will not work.* (2) *For more suitable values or windings for his set.* (3) *If* **PCGG** *should be strong enough to allow of the use of a loud speaker.* (4) *If results on this set would be as good as on a seven-valve receiver.*

(1) We can only suggest unsuitable values for the components, particularly inductances 2 and 3, and the grid battery 6. The circuit is admittedly tricky in operation. (2) Two and three should be suitable for about 5,000 metres, and grid batteries anything up to 10 volts. (3) Doubtful. The Circuit is intended particularly for shorter wavelengths. (4) This claim is rather far-fetched. The same may be said in a similar sense of any reaction circuit, but in practice a limit is imposed by the inherent stability of the valve. We should be extremely surprised if you got as good results as with a seven-valve set, except very occasionally when you happen to "fluke" a particularly lucky adjustment.

"**S.J.**" **(Stockholm).**—(1) The approximate wavelength of your set will be 3,500 metres. We regret that we have no information about this receiver, additional to that given in the article referred to.

"**G.B.**" **(Fulham)** *sends a description of his set and asks* (1) *For a diagram of connections.* (2) *If it will receive Broadcasting and* **2 MT.** (3) *How his wavelength could be increased.* (4) *If the apparatus described would be of any use in the assembling of a three-valve set.*

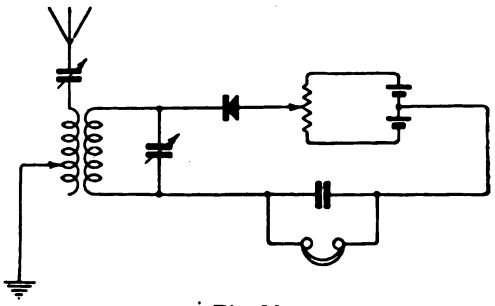

*Fig.* 10.

(1) See diagram (Fig. 10). (2) Quite satisfactory for London Broadcasting. If your aerial is a very good one, you may get Writtle very weakly. (3) By increasing the size of both coils. (4) Yes, all the parts except the crystal could be used for this purpose.

"**E.G.V.**" **(Woking)** *asks how to add a second valve to a circuit shown, using* 2 *H.T. and* 2 *L.T. batteries.*

The circuit shown is of a very inefficient type, and could only give good results with a variable tuning condenser across the anode coil. The use of separate H.T. and L.T. batteries on a two-valve set is unnecessary, and would serve practically no useful purpose. A suitable set for your purpose has been given to "**H.E.P.**" **(North Greenwich).** You can, of course, use separate batteries with each valve of this set if you prefer it.

"**M.F.**" **(Folkestone)** *asks re American short wave tuner described in June 8th issue* (1) *Suitable values for the condensers.* (2) *Whether fixed or variable.* (3) *If a crystal could be used in place of the valve.*

(1) 0·0002 mfd. for the grid condenser and 0·001 mfd. for the plate. (2) Condensers may be fixed but some slight advantage might be obtained by making the grid condenser variable. (3) No.

## SHARE MARKET REPORT.

Prices as we go to press on September 15th, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 7 | 7½ |
| ,, Preference .. .. | 2 | 3 | 3 |
| ,, Inter. Marine .. .. | 1 | 8 | 3 |
| ,, Canadian .. .. | | 10 | 6 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 14 | 0 |

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THE
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# On Heterodynes

## THE CONSTRUCTION OF A HETERODYNE WAVEMETER.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

IN the earlier articles in this series, which were published in these columns a few months ago, details were given for the construction of several forms of heterodyne oscillator. In all of these, separate plug-in coils were used in order to obtain the necessary wavelength range for the instrument. While this is a very convenient method to employ for the ordinary purposes of a heterodyne, the wavelength calibration of the instrument does not remain constant, since any small change in the relative positions of the tuning and reaction coils will alter the oscillation wavelength independently of any change in the setting of the variable condenser. Further, unless the coils themselves are very rigid, slight distortions of the coil windings may occur from time to time, which will cause changes in their constants and therefore also changes in the calibration of the instrument.

These difficulties can only be overcome effectively by building the coils into the instrument, and fastening them securely so that no changes can take place. When this is done the simple heterodyne becomes a heterodyne wavemeter which can be employed not only for the accurate measurement of wavelengths but also for numerous other radio measurements and tests as well.

While there are many ways in which such an instrument can be constructed, it is not necessary for many purposes to build it with all the care or refinements necessary for a standard laboratory wavemeter. Hence the design of the instrument described below aims at providing a simple apparatus which will meet most ordinary requirements without entailing an excessive cost in its construction.

The general outline of the arrangement used follows that employed in the first type of heterodyne described in this series of articles, in that an ordinary type of inductively coupled oscillation circuit is employed, using separate reaction and tuning coils (Fig. 1).

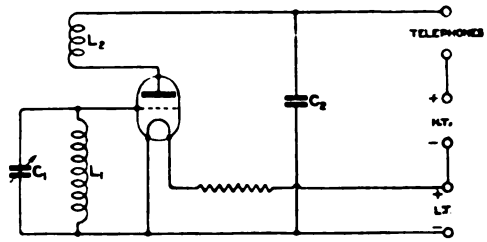


*Fig. 1. Inductively coupled oscillation circuit.*

The effective wavelength range is from rather under 150 metres up to approximately 30,000 metres, so that it covers most ordinary wavelengths encountered in radio working, and also overlaps the range of the short wave heterodyne, which has been described in these columns. It has also been found possible to enclose the apparatus in a box of the same outside dimensions as those of the above-mentioned short-wave heretodyne, so as to be uniform in style with that instrument.

The box is constructed of any convenient hard wood, ¼ in. thick, with outside dimensions of 9¾ ins. by 6 ins. by 4½ ins. high, so that when the top panel of ¼ in. ebonite is fitted in position the instrument will be 4¾ ins. high over all.

The top panel should be cut out from ebonite ¼ in. thick, to the dimensions of 9¾ ins. by 6 ins., and needs to have holes drilled in it in the positions shown in Fig. 2.

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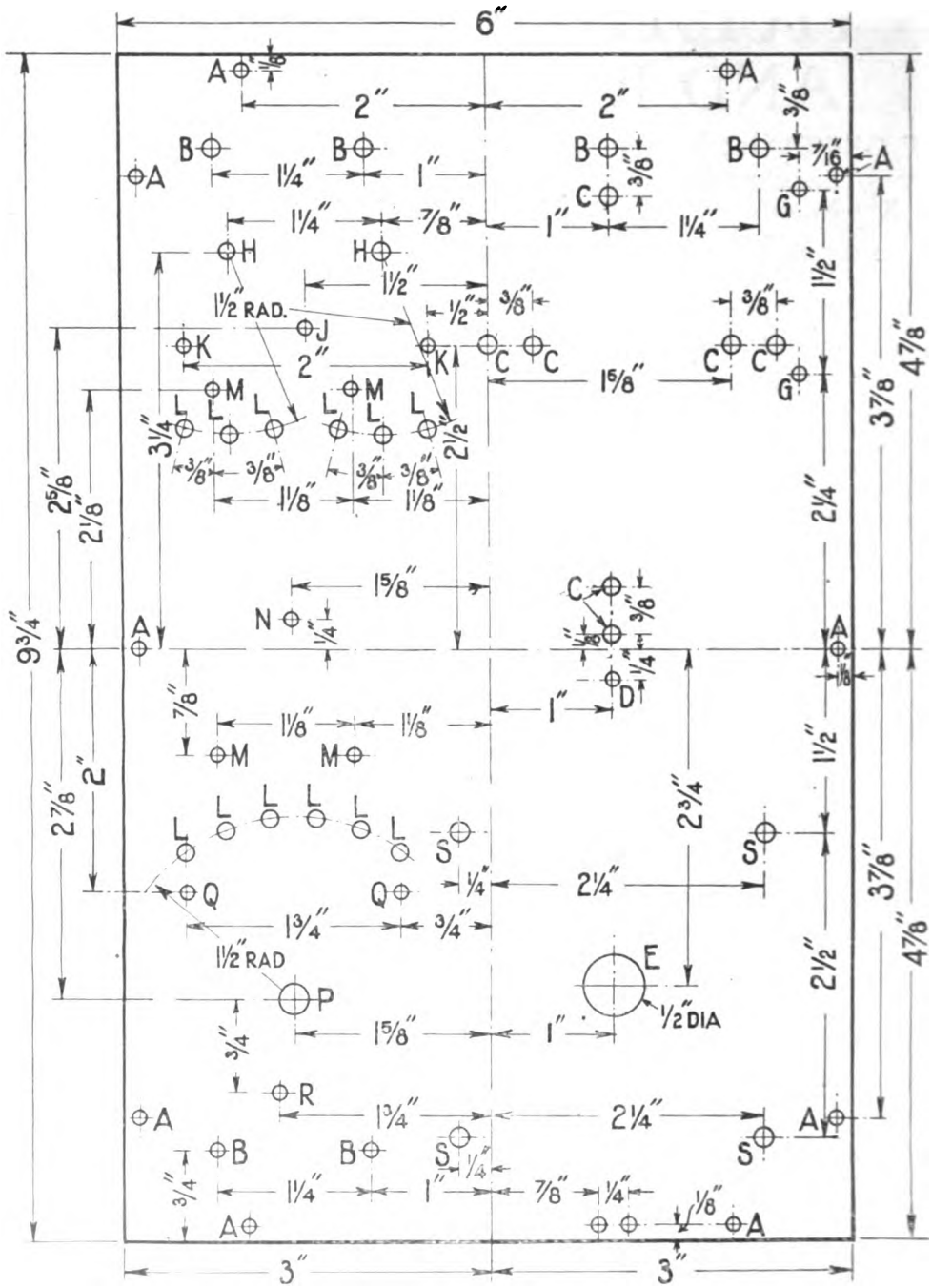


*Fig. 2. Drilling diagram (back view of panel).*

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This drawing is arranged so that the positions are ready for marking out directly on the *back* or underside of the ebonite panel.

The sizes and uses of the various holes lettered from A to S in Fig. 2 are set out below, as it is not easy to label the individual holes on the drilling diagram itself without unduly complicating the drawing.

A = Holes $\frac{1}{8}$ in. diameter, countersunk on surface for screws holding ebonite panel to box sides.
B = Holes for terminals, tapped 4 B.A.
C = Holes for screws for fixing valve holder contacts, tapped 6 B.A.
D = Hole, 4 B.A. clear, countersunk on front surface for screw fixing pillar holding short-wave coils.
E = Hole $\frac{1}{2}$ in. diameter for spindle and bushing of condenser.
F = Holes tapped 8 B.A. for condenser scale pointer.
G = 4 B.A. clearing holes, countersunk on surface for screws to hold ebonite frame for long-wave coils.
H = 1 B.A. clearing holes for switch spindles.
J = 6 B.A. hole for screw to hold brass bracket of long-wave coils.
K = Two 4 B.A. holes for stop pins of switch.
L = 4 B.A. holes for switch studs, at $\frac{3}{8}$ in. centres.
M = Holes for bracket carrying condensers 6 B.A. clear, countersunk on surface.
N = Centre of miniature tumbler switch for filament circuit.
P = $\frac{1}{4}$ in. diamater hole for switch spindle (0 B.A.).
Q = 4 B.A. holes for stop pins for switch.
R = 5 B.A. hole for stud to support end of 0·01 $\mu$F condenser.
S = Four blank holes drilled and tapped 4 B.A. to a depth of 3/16 in. into the ebonite. These are used for fixing the variable condenser in position, and would be required in other positions for some patterns of condenser.

When all the holes have been drilled and tapped to the proper sizes, the edges and front of the ebonite panel should be cleaned up, and polished or dull finished as preferred.

The front surface can then be engraved, if desired, with the appropriate lettering, as indicated in the plan of the instrument in Fig. 3.

For convenience in tuning, the inductances fitted into a wavemeter of this type should be subdivided into several coils. It has been found possible to limit the number of tuning coils to three in this instrument, and the number of reaction coils to two. For the longer wavelengths three duolaterally wound coils are used, two for tuning and one for reaction, while for the shorter waves two single layer solenoidal coils give good results.

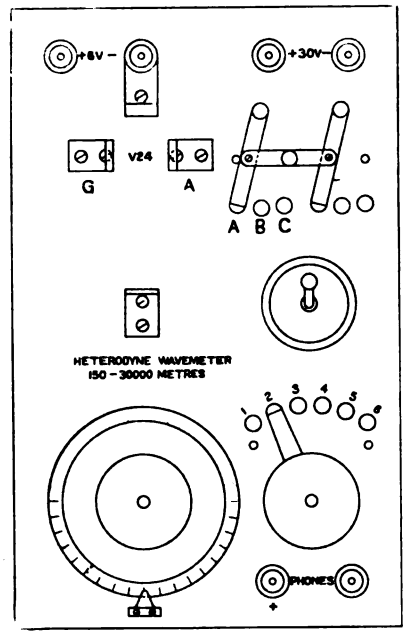


*Fig. 3. Plan of the instrument, showing engraving.*

The materials necessary for constructing this instrument are set out in the list below, from which it will be noted that it is proposed to utilise ready-made duolateral coils and variable and fixed condensers, since this method is usually the more satisfactory. The construction of the variable condenser and the duolateral coils, while quite easy, is a tedious process without the proper facilities, while the prices for which they can be purchased are not prohibitive.

MATERIALS USED IN CONSTRUCTION OF A WAVEMETER OF THIS TYPE.

| No. | DESCRIPTION. |
|---|---|
| 1 | 600-turn duolateral coil (inductance approximately = 24,000 microhenries). |
| 1 | 150-turn duolateral coil (inductance approximately = 1,380 microhenries). |

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1 100-turn duolateral coil (inductance approximately = 620 microhenries).

1 Variable air condenser of maximum capacity = 0·0015 microfarad, with standard knob and indicating dial.

10 6 B.A. by 7/16 in. cheese-head brass screws.

14 6 B.A. by $\frac{3}{8}$ in. countersunk-head brass screws.

10 6 B.A. by 5/16 in. round-head brass screws.

3 6 B.A. hexagon nuts.

6 4 B.A. by $\frac{5}{8}$ in. countersunk-head brass screws.

4 4 B.A. by $\frac{1}{4}$ in. cheese-head brass screws.

6 4 B.A. terminals, with nuts and washers.

2 1 B.A. by $1\frac{1}{4}$ in. cheese-head brass screws.

4 1 B.A. hexagon nuts.

4 0 B.A. hexagon nuts.

6 0 B.A. brass washers.

3 0 B.A. spring washers.

1 0 B.A. stud $1\frac{1}{8}$ in. long.

5 Fixed condensers of capacities of 0·0013, 0·0026, 0·0040, 0·0053, and 0·0065 microfarad. (Dubilier type 600A condensers are suitable.)

1 Fixed condenser 0·01 microfarad capacity (Dubilier type 577 condenser of this valve is suitable).

1 Miniature tumbler switch.

12 4 B.A. by $\frac{1}{4}$ in. by $\frac{1}{4}$ in. switch studs.

1 $1\frac{1}{2}$ in. diameter ebonite knob for switch.

3 8 B.A. by 3/16 in. round-head brass screws.

Phosphor bronze strip for switches and valve holder—thickness approximately 0·015 in.

1 Piece 6 ins. by $\frac{1}{2}$ in. by 3/32 in. brass strip for valveholder and coil bracket.

10 $\frac{5}{8}$ in. by No. 3 wood screws—brass counter-sunk heads.

4 4 B.A. switch stops.

1 V24 valve.

From the above, as well as from Fig. 3, it will be noted that a V24 valve is used in this instrument, as the low capacity of these valves renders them particularly suitable for use on the shorter wavelengths.

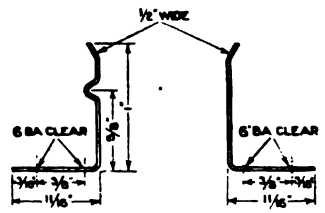


*Fig. 5. Dimensions of the contacts for the V24 Valve Holder.*

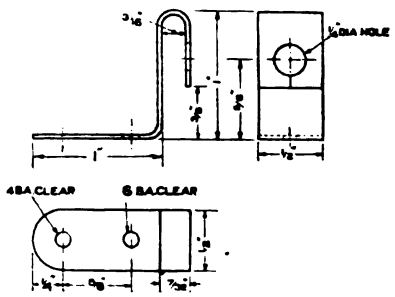


*Fig. 6. Dimensions of the contacts for the V24 Valve Holder.*

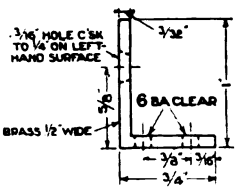


*Fig. 4. The rigid contact for V24 Valve Holder.*

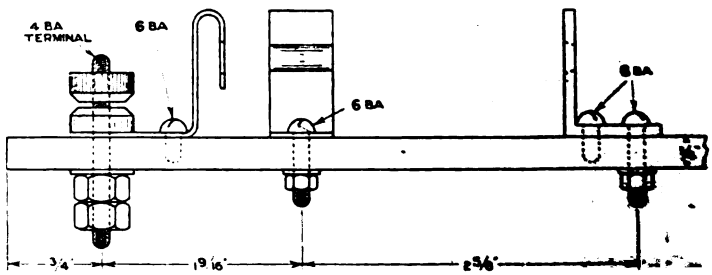


*Fig. 7. Showing how to arrange the V24 Valve Holder contacts, one of which is held under the 4 B.A. terminal with a 6 B.A. screw for fixing.*

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The parts of the valve holder may next be prepared. Valves of the V24 type require four contacts, three at least of which need to be of springy material in order to retain good contact with the valve caps. The fourth is

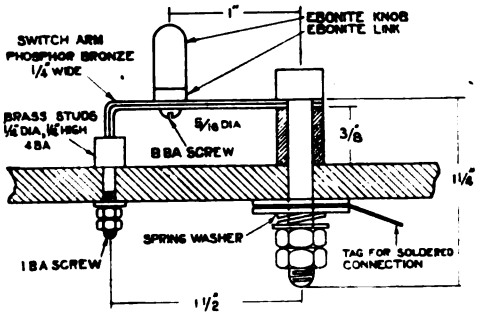


*Fig.* 8. *Arrangement of double-pole range switch.*

dreferably a rigid contact. The last may be bent up of 3/32 in. brass strip, ½ in. wide to the dimensions shown in Fig. 4, while the springy contacts are made of phosphor bronze about 0·015 in. thick. The dimensions of these contacts are given in Figs. 5 and 6.

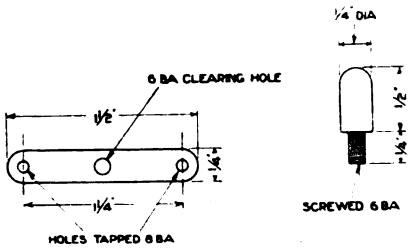


*Fig.* 9. *Details of link and knob for double-pole range switch (ebonite).*

One of the springy bronze contacts can be fixed in position under the 6 V — terminal, as indicated in Figs. 3 and 7, the latter giving

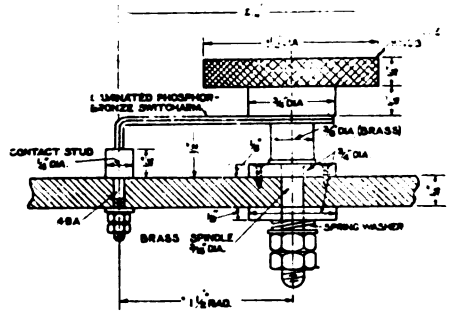


*Fig.* 10. *The six-way range switch.*

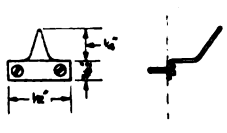

*Fig.* 11. *Dimensions of pointer.*

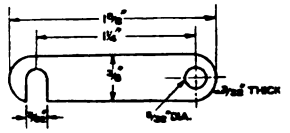

*Fig.* 12. *Dimensions of link.*

also the general arrangement and relative positions of the other contacts.

The double-pole range switch may next be prepared. The general arrangement of each arm is shown in Fig. 8. Each switch arm is built up of 5 phosphor-bronze strips ¼ in. in width, three of these being bent round to press on the switch contact studs, and the two intermeditate ones being cut short so as to space the contact laminations apart and give a better contact. The five strips should be rivetted together into a coherent whole at a distance of about ¾ in. from the centre of the spindle. The spindle or pivot for this switch is a 1 B.A. cheese-head brass screw, 1¼ ins. long, which after passing through the switch arm, is supported by a brass sleeve 5/16 in. diameter by ⅜ in. long, having a 1 B.A. clearing hole drilled through it. After passing through hole H (Fig. 2) in the ebonite panel, washers, a spring washer, and nuts are fitted to this screw on the underside of the panel.

The two switch arms, pivotted through holes HH (Fig. 2), should be linked together by an ebonite link, the dimensions of which are given in Fig. 9. This link is pivotted to the switch arms by two No. 8 B.A. round-head brass screws. In the centre of this link a small ebonite knob is fitted. This may be made of the size given in Fig. 9.

The studs for this and the other (six-way) range switch should be ¼ in. diameter by ¼ in. high, with 4 B.A. screwed shanks.

The six-way range switch may also be built up with five phosphor bronze strips or laminations, to the dimensions shown in Fig. 10. The 1½ in. diameter ebonite knob is screwed to the switch arm. A piece of No. 0 B.A. studding may be used for the spindle of this switch, and may be screwed into the underside of the ebonite knob.

For switching the filament of the valve on or off, a miniature tumbler switch may be used. No holes for this are shown on the

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drilling diagram, Fig. 2, since these switches vary somewhat in style and dimensions. The position of the centre of the switch is, however, shown on that diagram.

In the filament circuit of the valve a fixed resistance of 1 to 1¼ ohms should be fitted so that a six-volt accumulator may be used as the

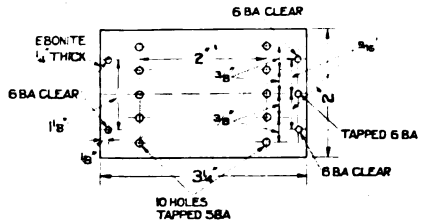


*Fig. 13. Platform for condensers.*

supply, giving about 5 volts on the valve terminals. A straight piece of No. 36 Ferry resistance wire slipped into a piece of sistoflex insulating sleeving may conveniently be used for this purpose, and may be used as one of the connecting wires in the circuit. A length of from 4 ins. to 5 ins. is about correct.

The variable air condenser should have a maximum capacity of approximately 0·0015 microfarad. This part is best procured ready made but can of course be built up if desired. In order that it may go conveniently into the available space its fixed plates should not exceed about 2¾ ins. or 2 13/16 ins. diameter. For a condenser of this size about 30 fixed and 29 movable plates usually gives about the correct capacity value. The overall depth of the condenser under the panel should not exceed 4¼ ins in order that it may go inside the box.

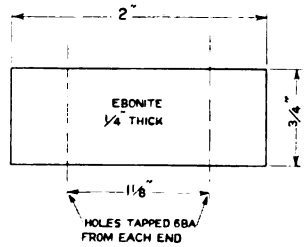


*Fig. 14. Support for condenser platform.*

The usual type of indicating dial fitted to these condensers requires a pointer fixed on the ebonite top of the instrument. Dimensions for such a pointer are given in Fig. 11. It should be fixed with two No. 8 B.A. round-head brass screws to the two holes marked FF in Fig. 2.

At the front of the instrument two terminals —marked "Phones" in Fig. 3—are fitted. These should be provided with a short-circuiting link so that the circuit may be closed if it is not desired to use telephones with the instrument. The dimensions of the link are given in Fig. 12.

The next consideration is the fixing of the additional condensers which are paralleled with the variable condenser by the six-way range switch in order to increase the capacity range of the set. In the instrument here described Dubilier Type 600 A condensers were used, since these take up very little mounting space, besides being of high insulation resistance and having great constancy of capacity. As there is insufficient space on the ebonite panel itself to mount these near the range switch, they must be screwed together on to an ebonite platform of the size given in Fig. 13. This should be

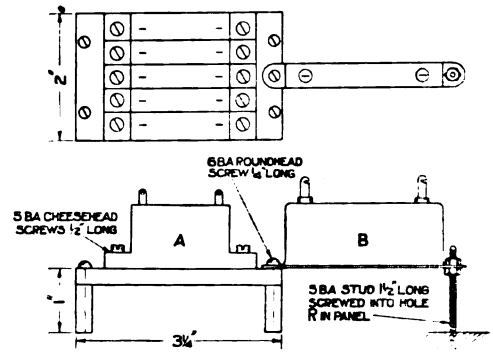


*Fig. 15. Arrangement of the condensers when mounted on their platform.*

supported from the panel by two strips of ebonite of the size shown in Fig. 14, these being secured to the instrument panel by 6 B.A. countersunk-head brass screws through the holes marked M M M M in Fig. 2. This platform also serves to support one end of another condenser (of capacity=0·01 microfarad) which is shunted across the telephones and H.T. battery. The condenser used here was of the Dubilier Type 577 pattern. Its other end was supported by a No. 5 B.A. brass stud screwed into the instrument panel (hole R, Fig. 2) the metal case of the condenser being clamped to this stud by two 5 B.A. nuts.

The general appearance of these condensers when mounted up on their platform is shown in Fig. 15.

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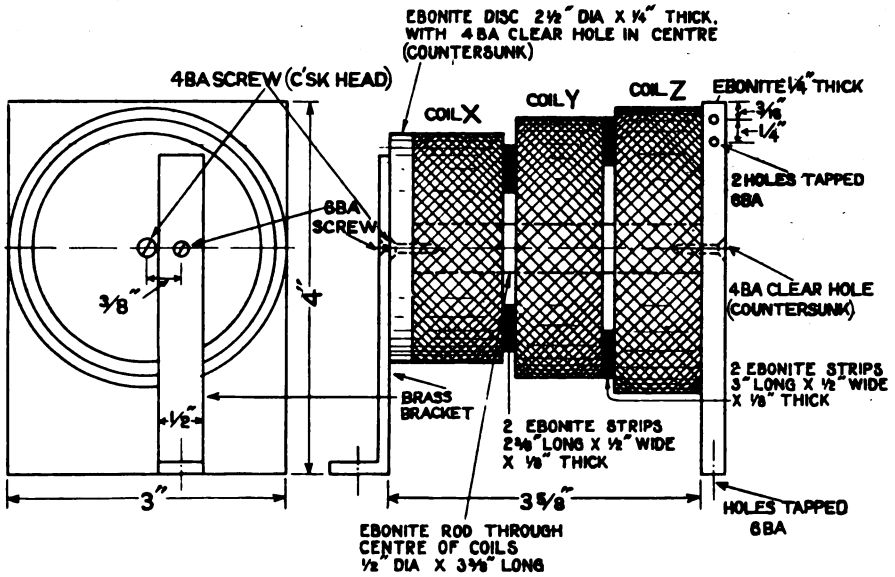
EBONITE DISC 2½" DIA X ¼" THICK, WITH 4 BA CLEAR HOLE IN CENTRE (COUNTERSUNK)
4BA SCREW (C'SK HEAD)
COIL X
COIL Y
COIL Z
EBONITE ¼" THICK
3/16"
¼"
2 HOLES TAPPED 6BA
6BA SCREW
3/8"
4"
4BA CLEAR HOLE (COUNTERSUNK)
2 EBONITE STRIPS 3" LONG X ½" WIDE X ⅛" THICK
BRASS BRACKET
½"
2 EBONITE STRIPS 2⅝" LONG X ½" WIDE X ⅛" THICK
3"
3 5/8"
HOLES TAPPED 6BA
EBONITE ROD THROUGH CENTRE OF COILS ½" DIA X 3⅝" LONG

*Fig.* 16. *Arrangement of mounting for long-wave coils.*

The remaining points to be considered are the mounting of the tuning and reaction coils, and the wiring up of the set.

For the longer wavelength ranges the three duolateral coils are used. These are clamped between two pieces of ebonite as shown in Fig. 16. One of these is attached to the instrument panel by two 6 B.A. countersunk-head brass screws through the holes marked GG in Fig. 2. The second piece of ebonite is in the form of a disc 2½ ins. in diameter. This is supported from the instrument panel by means of a brass bracket bent up from strip ½ in. wide by 3/32 in. thick to the dimensions given in Fig. 17. This bracket is secured to the ebonite disc at the ends of the coils by means of a single No. 6 B.A. countersunk-head brass screw as shown by the sketch on the left-hand side of Fig. 16. The lower part of the bracket is screwed to the instrument panel by a No. 6 B.A. brass screw into the hole marked J in Fig. 2. The coils marked X, Y and Z in Fig. 16 are separated from each other by ebonite strips ½ in. wide by ⅛ in. thick, two strips being placed between adjacent coils. In Fig. 16, coil X is the one having 100 turns, coil Y the one of 150 turns, and coil Z the one of 600 turns. The two pieces of ebonite at the ends of these coils are clamped together by two No. 4 B. A. countersunk head brass screws into an ebonite rod ½ in. diameter by 3⅜ ins. long, which passes up the centre of the coils.

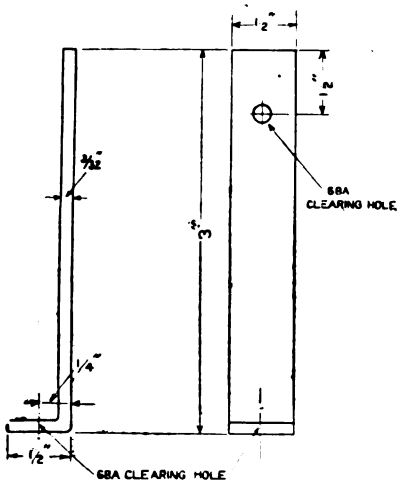


*Fig.* 17. *Brass bracket for supporting long-wave coils.*

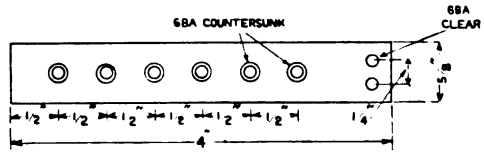


*Fig.* 18. *Terminal strip for coils.*

It will be noted that near the top of the right-hand piece of ebonite in Fig. 16, two holes are shown tapped 6 B.A. These are to support a



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strip of ebonite, carrying terminals to which the ends of the fine wire winding of the coils can be connected. The dimensions of the strip are given in Fig. 18. It has six holes in it through which are screwed six No. 6 B.A. countersunk-head brass screws, $\frac{3}{8}$ in. in length, these screws being provided with nuts and washers under which wires may be gripped. This row of screws and nuts provides a connecting means for the short-wave coils as well as for the duolaterally wound long wave coils.

The short-wave tuning coil consists of 25 turns of No. 20 S.W.G. double cotton covered bell wire, wound with adjacent turns touching on an insulating former $2\frac{1}{4}$ ins. in diameter by $2\frac{1}{4}$ ins. long, the ends of the wire being secured in place by passing through holes in the former. A stout paxolin tube forms a convenient support for this winding.

The short-wave reaction coil consists of 80 turns of No. 28 S.W.G. double silk covered copper wire, wound with adjacent turns touching, on an insulating former $1\frac{3}{4}$ ins. diameter by $2\frac{1}{4}$ ins. long, the winding being arranged to occupy the centre of the length of this tube. A paxolin tube may again be used for this purpose. These two coils when completed are arranged concentrically, and clamped between two ebonite discs $2\frac{1}{4}$ ins. diameter by $\frac{1}{4}$ in. thick, as shown in Fig. 19, the two

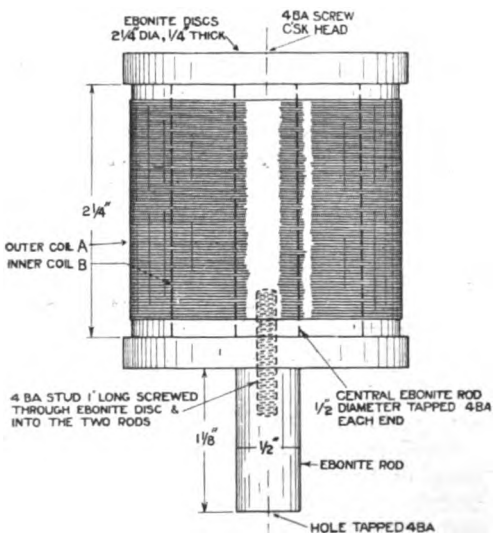
EBONITE DISCS 2¼" DIA, ¼" THICK
4BA SCREW C'SK HEAD
2¼"
OUTER COIL A
INNER COIL B
4 BA STUD 1" LONG SCREWED THROUGH EBONITE DISC & INTO THE TWO RODS
CENTRAL EBONITE ROD ½" DIAMETER TAPPED 4BA EACH END
1⅛"
½"
EBONITE ROD
HOLE TAPPED 4BA

*Fig. 19. Arrangement of short wave coils and supports.*

discs being held together by an ebonite rod $\frac{1}{2}$ in. in diameter, passing up the centre of the coils and screwed to the discs at each end. Before finally clamping up these coils the space inside the smaller coil and between the two coils should be filled up solid with paraffin wax so as to maintain the coils rigidly in the same relative positions.

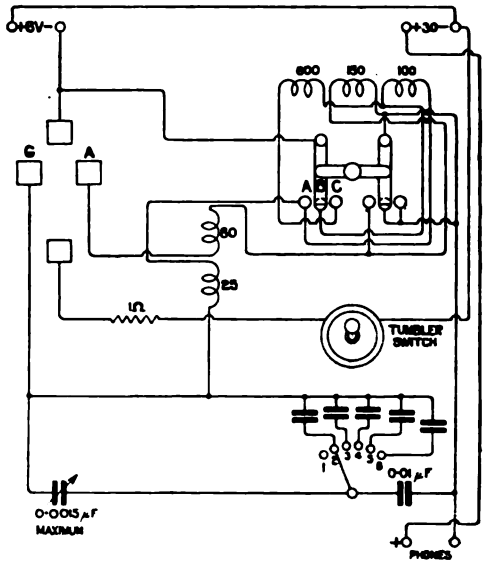


*Fig. 20. Wiring for the wavemeter.*

When completed this pair of coils is mounted with its common axis vertical by means of an ebonite rod $\frac{1}{2}$ in. diameter by $1\frac{1}{8}$ in. long, screwed to the lower ebonite disc by means of a No. 4 B.A. brass stud 1 in. long, which also serves to secure the lower disc to the ebonite rod passing between the two discs as sketched in Fig. 19. This lower ebonite rod carrying the coils is fastened to the instrument panel by means of a 4 B.A. brass screw through the hole marked D in Fig. 2. When in this position the centre of the length of these coils should be level with the axis of the long wave coils, which are mounted across the width of the box, so that the axes of the two sets of coils, being at right angles to one another, the mutual coupling between them is a minimum. If this precaution is not taken, the proximity of the long wave coils may prevent the production of oscillation on the shorter wavelength ranges. As a further aid to eliminating such disturbing action, it is desirable to short circuit any of the coils that are not in use. This can be done automatically by the double pole range switch, in the manner shown by the connection scheme of Fig. 20. This figure gives the wiring diagram for the

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whole set, and it is desirable to arrange the connecting wires as nearly as possible in the manner sketched in this diagram, taking particular care to space the wires apart as far as possible and in particular to keep the path through which the unused portions of the windings are short-circuited as short as possible.

The five fixed condensers, of which the values have been given above, are connected up to contacts 2, 3, 4, 5, 6 of the six-way range switch, the condenser of lowest capacity (viz., 0·0013 microfarad) being joined to contact 2, and the largest condenser of 0·0065 microfarad capacity being joined to contact 6 of the range switch.

All wiring should be carried out in No. 18 S.W.G. tinned copper wire as this is sufficiently stiff to remain fairly rigid. Sistoflex insulating sleeving should be used where necessary, and it is desirable to solder all joints and connections in an instrument of this type.

When the wiring has been completed the instrument should be tested for the production of oscillations throughout the entire tuning range. A simple way of effecting this test is to repeatedly touch the grid terminal of the valve with a moistened finger, when, if the valve is oscillating, a sharp click will be heard in the telephone receivers both on touching and removing the finger from the grid terminal. If oscillations are not produced on one of the ranges, the connections to the appropriate coil should be reversed, while in wiring up it is advantageous to bear in mind that when looking at the coils so that the windings run in the same direction, the connections to the grid and anode of the valve should go to opposite ends of the tuning and reaction coils respectively.

# The All-British Wireless Exhibition.

## NOTES ON SOME OF THE APPARATUS SHOWN.

THE present issue of this journal bears the date of September 30th. This is the date of the opening of the All-British Wireless Exhibition at the Horticultural Hall, Westminster.

As has already been announced in these columns, the Exhibition will remain open from September 30th to October 7th, inclusive. Everything wireless which the British manufacturer has produced will be represented at this Exhibition and whilst it will be the endeavour of this Journal to refer to the majority of the principal exhibits space will not of course allow for a detailed description of all of the very numerous pieces of apparatus, though most of them no doubt merit individual notice and description.

In the following pages reference is made to the apparatus to be seen on a number of the stands and in a later issue those products not referred to in the following descriptions will be dealt with in so far as space permits.

It is of course not possible, prior to the Exhibition, to obtain information concerning all the new types of apparatus which the Exhibition will disclose, as details concerning many of these will not be available until the opening of the Exhibition.

Arrangements have been made by the organisers of the Exhibition for wireless telephony transmissions to be conducted specially for the Exhibition, when, at the Horticultural Hall these transmissions will be received and made audible in the Hall. A special musical programme has been arranged. Half-hour telephony transmissions on 360 metres will take place daily at 11, 3, 6 and 8 o'clock.

No doubt the Exhibition will do much to add to the popularity of wireless by introducing the public to the possibilities which Broadcasting is about to open up. At the same time engineers and research students will find in the Exhibition an endless source of interest. A description of some of the exhibits follows:—

### The Zenith Manufacturing Co. (Stand No. 3).

At this stand a complete range of regulating resistances is shown suitable for the adjustment of current and voltage in all wireless and similar circuits. These resistances incorporate many improvements.

A potentiometer resistance is shown arranged to permit the measurement of the voltage amplification factor of any given valve in accordance with the methods described by Mr. P. R. Coursey in *The Wireless World and*



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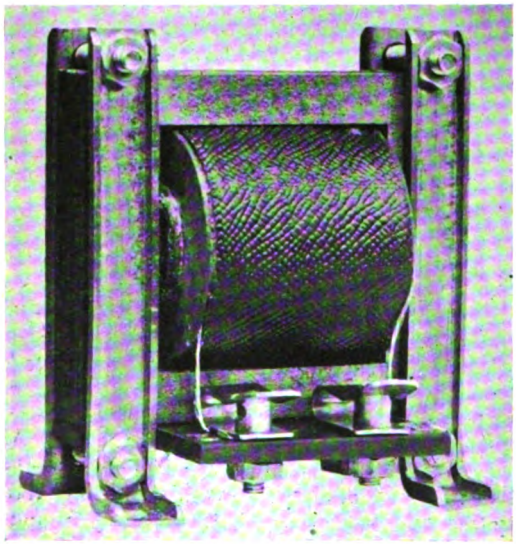
*Radio Review* of February 4th. As this potentiometer resistance is a very moderate priced article it should be of particular interest to experimental workers.

New "Zenite" resistance units are also shown. This particular unit comprises a fire-resisting tube on which is applied a suitable winding of resistance wire ultimately embedded at high temperature in a vitreous enamel. As these resistances are then impervious to moisture or oxidisation, the value remains constant, and they are specially useful for various wireless circuits, especially as grid leaks for large transmitting valves.



*"Igranic" Intervalve Transformer.*

Other exhibits include high tension transformers, choke coils and smoothing condensers such as are used for obtaining high tension rectified current for feeding the plate circuit of moderate power transmitting sets. These transformers, choking coils and condensers are made in a very large variety of ways to fulfil all requirements, and to minimise the humming noise so frequently associated with experimental telephony transmission.

Where continuous current is available, accumulator charging is a simple matter, and many types of regulating resistances are shown suitable for adjusting the charging current for the various types of accumulators in common use, but when an experimenter resides in a neighbourhood supplied only with alternating current power, the problem is a more difficult one, as in that case some form of rectifier or converter is essential. A variety of rectifiers which will overcome all such technical difficulties are shown.

Amongst accessories exhibited may be mentioned grid leaks and condensers of all kinds.

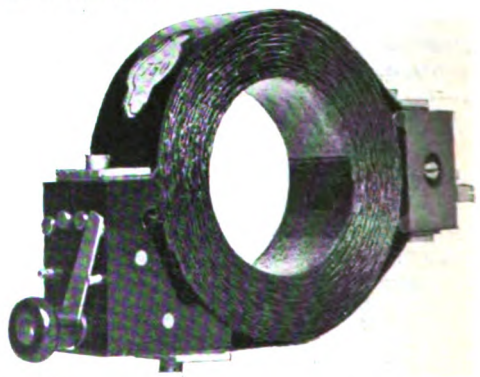
### Igranic Electric Co., Ltd. (Stand No. 4).

The salient feature of the exhibit of this firm is the manufacture of coils for wireless work. With a view to demonstrating the advantages of the honeycomb type of inductance coil an enlarged model of a coil is exhibited to clearly illustrate the duolateral formation.

The majority of radio enthusiasts know that this formation, by attaining the maximum spacing between the various turns of wire, reduces the self-capacity of the coil in comparison with that of concentrically wound coils, and makes sharper tuning possible with consequent increase in signal strength.

Slab inductance coils, wound by the self-forming cross-wind method, are also exhibited, as well as transformer coils, which embody two methods of winding, viz., the "paper interlay" and the "cotton interweave."

Three coil winding machines are actually at work on the stand. One of these is employed in making honeycomb coils, the second in winding transformer coils with paper interlay between successive layers, and the third in making transformer coils by the cotton interweave method.



*"Igranic" Tapped honeycomb coil with 4-contact switch.*

The ingenious means by which the paper is interlaid between the layers as the winding proceeds, and exceptionally durable character of the transformer coils made by the cotton interweave method, is specially attractive.

Turning from coils, the exhibit is interesting also because of the display of various types of

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coil-holders for tuners. The "Micro-Adjusta" coil-holder is designed for exceptionally fine tuning, where adjustment of coupled coils needs to be carried out very accurately, as in telephony. The "Triplug" coil-holder, is suitable for table use or for panel mounting.

The neat design and exceptional finish of these accessories will commend them to users.

A patented method of mounting both honeycomb and slab inductance coils is on view. In this method, which is called the "Gimbal" mounting, the coil is provided with pivots at right angles to its axis, so that when tuning the coil can be rotated about its own pivot as well as moved radially, thus affording what might be described as a vernier adjustment. A conspicuous advantage of this method of mounting is that two coils connected in series can be used as a variometer. A very interesting and new design of honeycomb-wound variometer is on view as well as one or two types of intervalve transformers.

**Harwell, Ltd. (Stand No. 5).**

A new Replaceable Dry Battery for wireless receiving sets is exhibited here. It is made by Semaphore, Ltd., for whom this firm acts as sales managers.

Each cell is stated to have about five times the life of the standard battery and they are made up in units of two cells, *i.e.*, three volts nominally. Each two-cell unit is connected together with a special brass coupling (with holes for tapping at any voltage) so that no soldering is required. Either six or twelve units are fitted in a box and any quantity of such boxes can be put together where more than 36 volts are required.

Any two-cell unit can be replaced at a very low cost if one gives out, thus avoiding any necessity of scrapping the whole battery.

The ordinary high voltage Semaphore Batteries are also being shown, but it is claimed that the new cell is distinctly novel and a decided improvement.

A brass coupling for connecting ordinary flash lamp batteries is also on view. Messrs. Harwell also control the sales of the Solidite Manufacturing Company, Ltd., who make moulded valve-holders of all types, knobs, sliders and various articles made out of Solidite Insulating Material.

Voltmeters and ammeters for wireless work are displayed and also an instrument termed a "radio-gramophone," which is a combined valve receiving set and gramophone, contained in a neat cabinet.

**T. H. Isted (Stand No. 9).**

The above firm show an instrument described as the Broadcast Receiver "De Luxe."

It is designed to stand on a table, in a vertical position, so that it may be moved to any part of a room into which the aerial is led.

It has five valves, one being the detector and the remaining four being L.F. amplifiers.

A filament resistance is fitted to each valve, which serves also to cut out valves that are not required. Any number can be used, from two valves up to five, by means of switches at the bottom of the panel.

A change-over switch is provided for telephones or loud speaker.

A distinctive feature is the utilisation of the off position of a filament switch to connect the aerial to earth.

The aerial and earth lead-in terminal are in a small ebonite panel on the right of the cabinet. The H.T. and L.T. batteries are accommodated inside and are easily accessible by means of a small door at the foot of the cabinet.

Everything being included in the cabinet, it forms a complete receiving station in itself. So simple is the operation, that once the station has been calibrated to its broadcast station and others that are within its receiving area, and a note made of their positions on the condenser, it only needs two actions of switching to receive the broadcasting.

**Hart Accumulator Company, Ltd. (Stand No. 17).**

The following "Hart" exhibits are shown:—

*High Tension Batteries.*

1. "Hart" 50-volt "PL" type batteries, in specially insulated ebonite boxes of good design, contained in waxed wood cases with outside terminals and regulating switch (if required). Capacity 1·2 ampere hours.

2. Special 24-volt "DPL" 3-plate batteries, fitted in specially insulated glass boxes of latest design. This battery is entirely new, and has no equal for the high tension circuit of the wireless system. Capacity 2·5 ampere hours.

3. 24-volt "PL.3" type battery, fitted in specially insulated glass boxes, exactly as above, but 1·2 ampere hours capacity.

4. 2-volt "DPL.3" cell, in sealed glass box.

5. 2-volt "PL.3" cell, in sealed glass box.

Items 4 and 5 are 2-volt cells as used in the above 24-volt sets.

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6. Set of 17 cells (32 volts) for ship wireless installations, as supplied for transmission work.

*Low Tension Batteries.*

7. Portable batteries in celluloid boxes of various voltages and capacities.

8. Portable batteries in sealed glass boxes of various voltages and capacities with wood crates and carrying handles. This is a type now greatly in demand.

9. "MEU" type "splash-protected" accumulators. These are specially used for portable wireless outfits, voltage 2, 4 or 6. Capacities 10-100 ampere hours.

10. 6-volt portable accumulators in sealed glass boxes fitted in wood crate with leather strap handle. This size is of larger capacity than usual, and is introduced to meet the growing demand for larger capacity cells for multi-valve circuits. Capacity 67 ampere hours.

*General Types.*

11. 6 and 12-volt "Hart" motor starter and lighting batteries as used for replacement on all makes of cars. Capacities 45-123 ampere hours.

12. 2-volt "AP.7" cells in ebonite boxes as largely used by the Admiralty. Capacity 11 ampere hours.

13. Portable hand lamps in case fitted with tumbler switch and 4-volt accumulator. Capacity 45 hours light on one charge.

14. 2-volt inspection lamp outfits, fitted with accumulator. In demand for meter reading work, inspectors, railway officials, electricity and gas undertakings, etc.

15. "PL.3" type cells in celluloid boxes. These represent the exact size to replace dry cells in the usual standard type of flash lamp case. They are a great saving in cost, and are easily recharged.

All capacities mentioned represent actual output based on continuous rating.

**J. A. Coomes & Co., Ltd. (Stand No. 18).**

A broadcasting receiving set of new design, styled the "Ionophone" is exhibited on this stand.

In the design of this receiver the variable condenser has been eliminated and tuning is done entirely by means of fixed condensers and variometers, the latter of their own design.

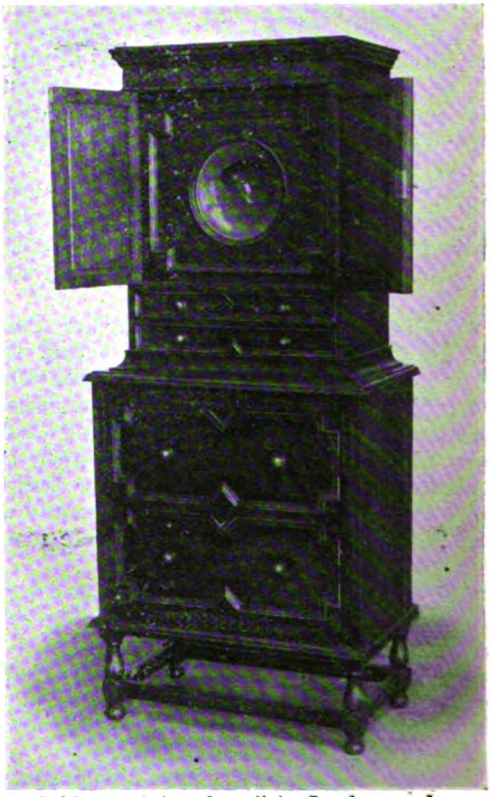
The variometer gives sharp tuning over a range from 200-3,000 metres wavelength, so that the Hague concerts and Eiffel Tower meteorological reports and time signals can be obtained as well as all the ordinary broadcasting wavelengths.

The set is so arranged, in view of the regulations of the P.M.G., that self-oscillation is impossible.

The receiver consists of two radio-frequency amplifying valves with a radio frequency intervalve transformer of the firm's own design, a rectifying valve, telephone transformer, and low resistance telephones.

Where extra amplification is required, a two-valve audio-frequency amplifier is supplied for attachment to the set.

In addition there are exhibited intervalve transformers, telephone transformers and variometers.



*Cabinet "Aristophone" in Jacobean style.*

**C. F. Elwell, Ltd. (Stand No. 23).**

Cabinet "Aristophones," for drawing-room use, having specially designed cabinets, which are accurate period reproductions and contain the whole of the wireless apparatus, including batteries and "loud-speakers" form a special feature of this exhibit.

The loud speaker has novel features, being hand moulded of a wood fibre compound to proportions which have been scientific-

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ally ascertained for the greatest purity of tone, resulting in a shape resembling that of the human ear. The wireless receiver is unusually simple, and it is apparent that great care has been taken to design an instrument with very few adjustments.

One particularly interesting exhibit is a lacquer-work china cupboard and bureau of 1722, into which wireless apparatus characteristic of 1922 has been built.

"Aristophone" cabinets are shown in Cromwellian, Sheraton, Lacquer, and Adams styles.

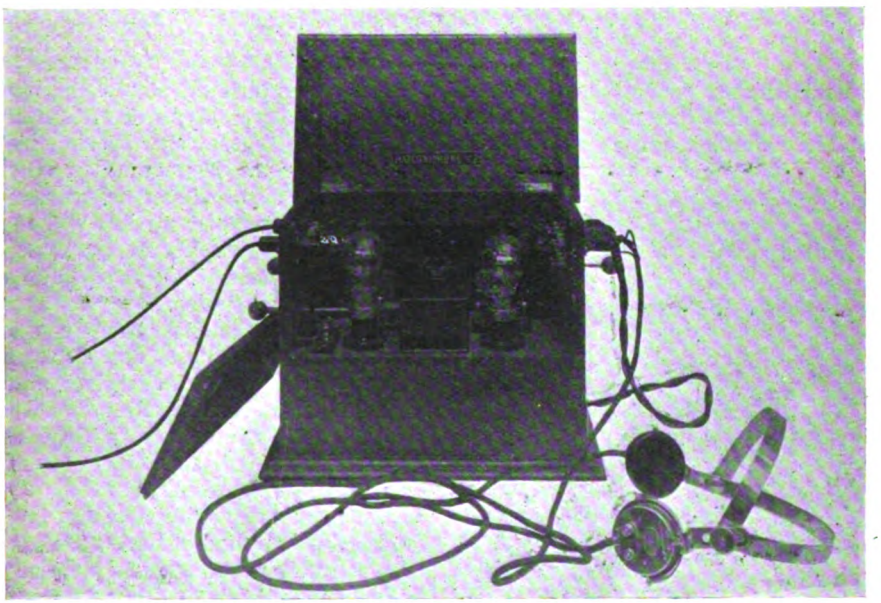
*An Elwell accessory. A "bull-dog" grip terminal.*

Various types of special "Polar" receivers and amplifiers for long range reception and various wavelengths are also shown.

**Marconi's Wireless Telegraph Company, Ltd. (Stand No. 24).**

The exhibit includes several pieces of historical apparatus showing the advance which has been made in wireless science during the past 25 years, and also a number of the latest wireless instruments. The latest pattern Wireless Direction Finder, as installed at the London Air Port for the Air Ministry, and as used by the British Post Office, and in numerous foreign aerodromes is shown. This is known as Type 12a and is designed for use on land in connection with the navigation of ships and aircraft. It provides a means for accurately determining the plane of received signals and the absolute direction of reception. The sensitiveness of this instrument is such that it may be used for ordinary reception with satisfactory results, and in this connection its directional properties are of very considerable value in the presence of "jamming." Change from directional reception to uniform all-round reception can be brought about instantaneously by the operation of a single switch, and the circuits are equally suitable for the reception of spark, tonic train, telephony or continuous wave signals. The wave range lies between 300 and 4,500 metres.

In conjunction with this instrument there is also shown the Aircraft Wireless Telephone Transmitter and Receiver, Type A.D.2, such as is fitted to British commercial aeroplanes flying between London and the Continent, and to machines in all parts of the world. This set is primarily designed for wireless communication—telegraphic or telephonic—between aircraft and ground stations or to other aircraft. Its chief characteristic is that it combines in one box both transmitter and receiver, connected per-



*"Marconiphone" Type "V.2" Receiver.*

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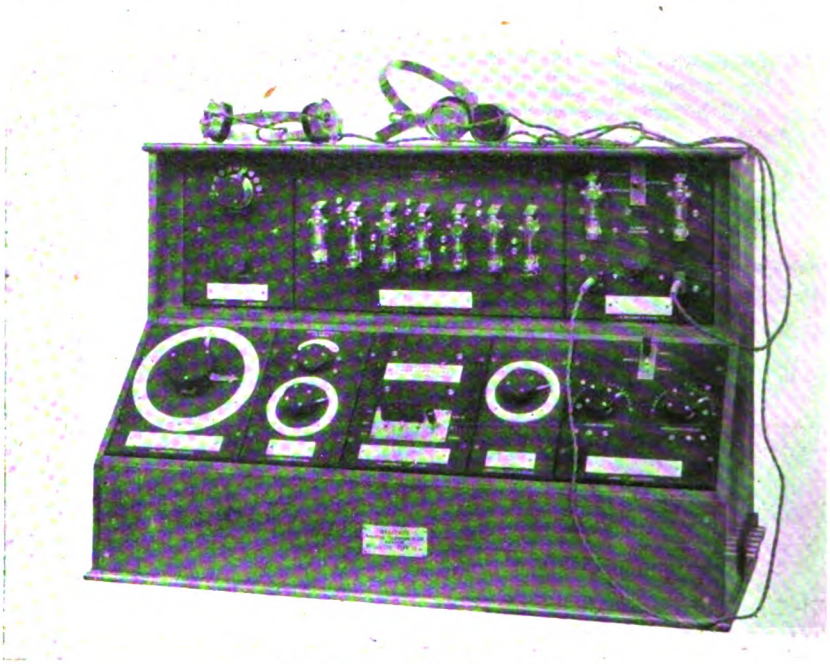
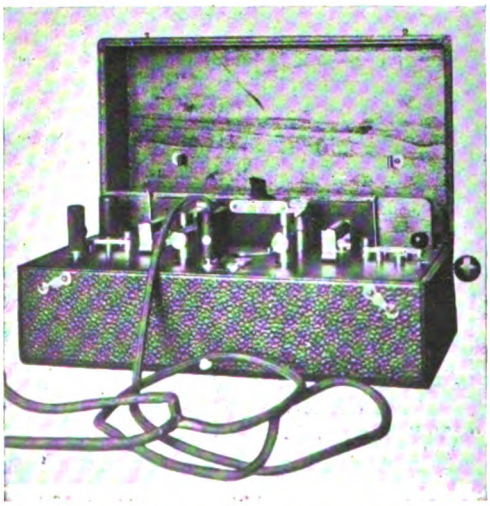
manently by cables to a small unit which carries all the handles necessary for controlling the set. This small unit, called the "Remote Control," can be mounted conveniently to the hand of the user, while the set proper can be stowed permanently away in the most convenient position. The principle of remote control enables a pilot, while flying, to have all the necessary adjustments for both sending and receiving either telegraphy or telephony in a very compact space. A small wind-driven generator supplies all power for transmission.



*The Marconi Direction Finder.*



*A "Marconiphone" Crystal Set.*

There are several types of "Marconiphones" on view. These are special instruments designed by the Marconi Company for the reception of broadcast telephony in the home. The popular models will include the two-valve receiver known as Type V.2 and two Crystal receivers known as the Crystal "A" and the Crystal Junior.

The V.2 model has been constructed to meet the new Post Office requirements, which specify that the receiver must not be capable of radiation. Reaction is not employed, but a throw-back circuit is utilised by means of which additional low frequency magnification is obtained. The "grid condenser" method of rectification is employed, and a novel method of tuning is used in which the inductance of a fixed coil is varied by means of a copper spade. Inductance units are interchangeable. The set has been so designed that either "R" or "Dull Emitter" valves can be fitted, the latter permitting of the operation of the set from dry cells instead of accumulators. This receiver has a guaranteed

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range of 50 miles from a broadcasting centre, on the broadcasting wavelengths.

The Marconi Crystal "A" is an attractive

*A Marconi exhibit of historical interest—An early coherer.*

crystal model fitted with two types of crystals, galena and carborundum. It employs the same system of tuning as the "V.2," and there is an automatic adjustment for the carborundum crystal. There is provision for two pairs of telephones.

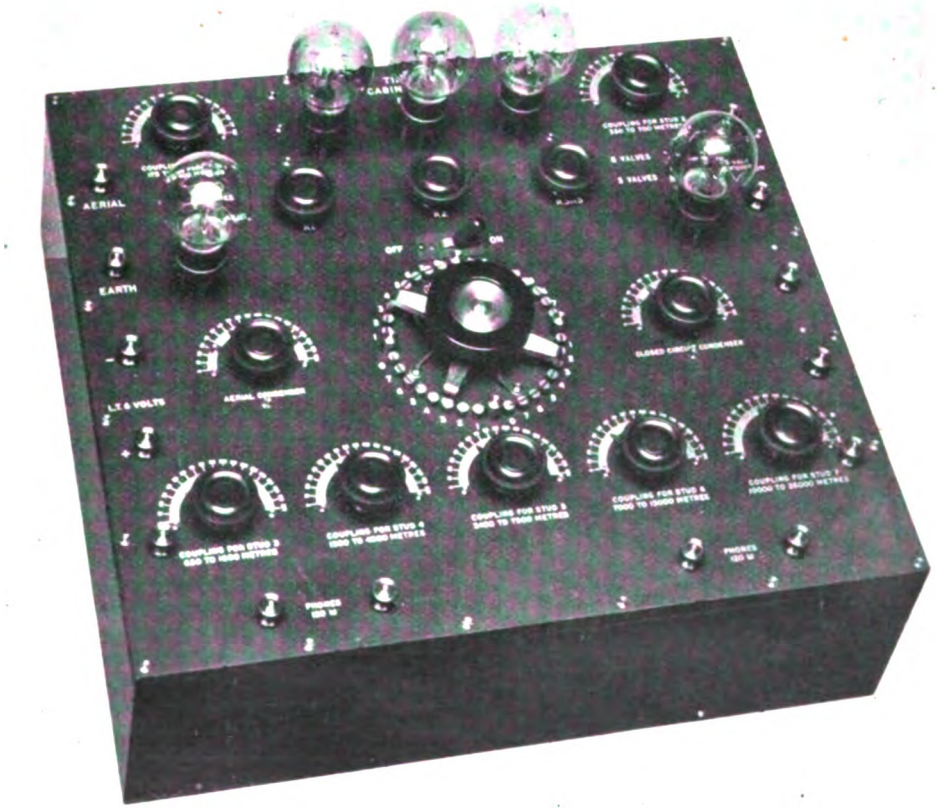
The Marconi Crystal Junior has two interchangeable crystals, galena and carborundum, with automatic adjustment for the latter. It has a single circuit tuning system, employing the "spade" method, and the range is from 10 to 12 miles. There is provision for one single earpiece headphone.

### W. Robert H. Tingey (Stand No. 25).

The special feature of the exhibits on this stand is undoubtedly the receiver, which covers the complete wavelength range with equal efficiency on all wavelengths and is possibly one of the first instruments put on the market designed to accomplish this.

### H.P.R. Wireless, Ltd. (Stand No. 35).

Up to the present the wireless recruit has always been faced with two big difficulties —how to tune his instrument quickly and




*A Tingey Universal Receiver.*

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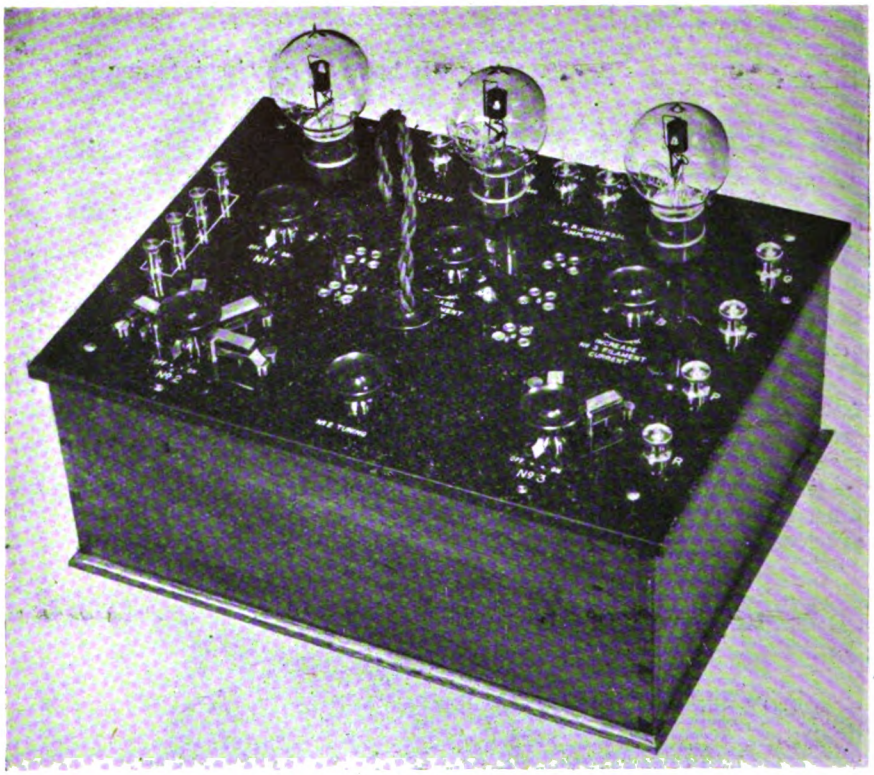


*An H.P.R. Tuner and Amplifier.*

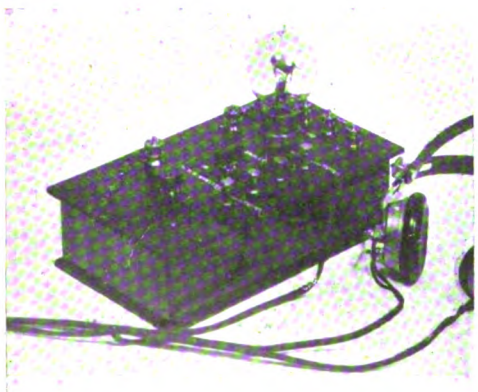
accurately to the known wavelength of the stations he wants to pick up, and how to recognise from the signals he is receiving on his instrument the station which is transmitting them.

By the use of the H.P.R. Patent Automatic Wavelength Indicator, invented by Mr. H Powell Rees, all these difficulties are cleared away. "Tuning-in" becomes as simple as turning on a gramophone.

Each H.P.R. Universal Tuner includes a specially calibrated wavelength indicator. By setting the pointer to the figure of the wavelength, the required station is immediately picked up. If unknown signals are coming through, it may usually be ascertained in an instant which station is sending. The operation is as certain as switching on an electric light.

The Automatic Wavelength Indicator may be described as an "indispensable guide to the ether."

The "Simplex" Wireless Phone which fulfils the conditions of the Postmaster-General for "broadcast receiving," is thoroughly efficient and no wireless knowledge is required for its manipulation. Gives the concerts, etc., at their best by turning a handle. Magnifying apparatus may be added if desired.



*The "Simplex" Wireless Phone.*

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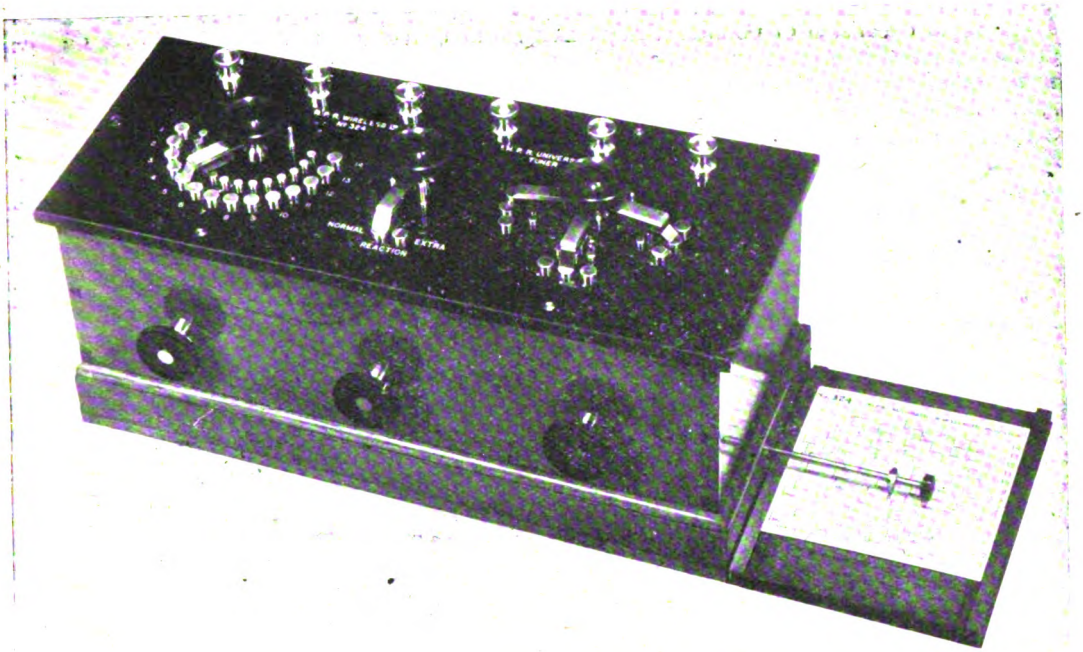
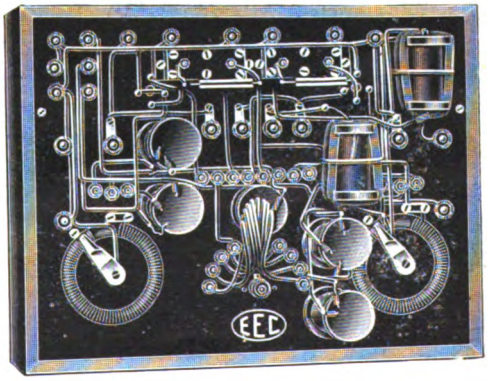


*The Universal Tuner with wavelength indicator.*

**Economic Electric Co., Ltd. (Stand No. 51).**

An instrument designed for recording wireless signals is of special interest. It employs the principle of two valves balanced in opposite links of a wheatstone bridge which is a particularly efficient method for causing feeble oscillations to operate a relay.

Another instrument, termed an "Oscillator," is a device for adding in a receiving circuit to permit of the reception of continuous wave signals over a wavelength range of 3,500/25,000 metres.




*A Valve Bridge used for Recording Wireless Signals.*

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## The Dubilier Condenser Co. (1921), Ltd. (Stand No. 36.)

The rapid expansion of popular interest in all radio matters is emphasised by the exhibits to be found on the stand of The Dubilier Condenser Co. (1921), Ltd., which show the principles adopted in the well-known condensers manufactured by this firm for use on the larger wireless installations applied to the requirements of radio receivers.

For use with wireless receiving apparatus four patterns of fixed condensers are shown, known respectively as the Type 600, with and without grid leak attachment, the Type 600A and the Type 577 condensers. These condensers are all constructed with carefully selected mica dielectric and are built up on the same principles as those adopted for the larger power condensers.

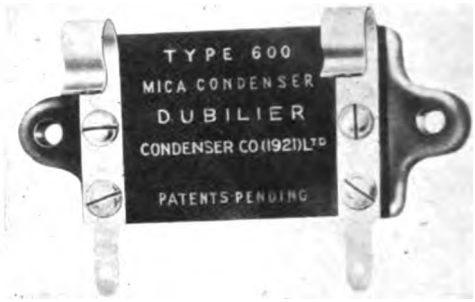
The Type 600 condensers are made in two patterns, one carrying clips into which a grid leak resistance can be pushed, and the other having tag connections only, to which the

*The "Ducon" attachment for enabling the electric lighting wires to be used for radio receiving with perfect safety.*

external leads can be soldered. These condensers are enclosed in a moulded insulated case and have very high insulation resistance and the absolute minimum of losses.

The Type 600A condenser is of very similar type, but is designed for mounting on edge, so as to economise the space required on the instrument panel. It is not provided with clips for a grid leak, but merely with metal tags to which connections can be soldered. These three patterns of condensers are supplied in any value desired up to 0·005 microfarad.

The Type 577 Universal Condenser is also constructed with a mica dielectric and is




*Condenser for use in receiving circuits fitted with clips to carry leak resistance.*

enclosed in a metal case. It is suitable for use in wireless receiving and in low power wireless transmitting circuits, for the parts of telephone repeaters and many similar purposes. Extreme constancy of capacity is the main feature of this condenser, while the metal case which can be earthed also forms an efficient electrostatic screen. This type is available in any capacity up to 0·01 microfarad.

For the more elaborate types of receiving apparatus such as are used by amateur experimenters and in the better class of broadcast

*Designed specially for panel mounting, measuring only 2¾" × ¾"*

receiving apparatus, special patterns of variable air condensers were exhibited by this firm, Variable air condensers ("Varicons") of the moving vane type are shown in three patterns,

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suitable respectively for panel mounting, for ordinary experimental purposes, and as a laboratory condenser, the difference being in the type of case fitted to the condenser.

A novel pattern of variable air condenser (known as the "Sphericon") is also shown, in which the electrodes are in the form of hemispherical shells, fixed and movable shells being interleaved with one another somewhat similar to the arrangement of the moving vane

*A Universal Condenser for use in receivers and low power transmitters.*

condenser. This arrangement secures great mechanical rigidity and ensures constancy of calibration.

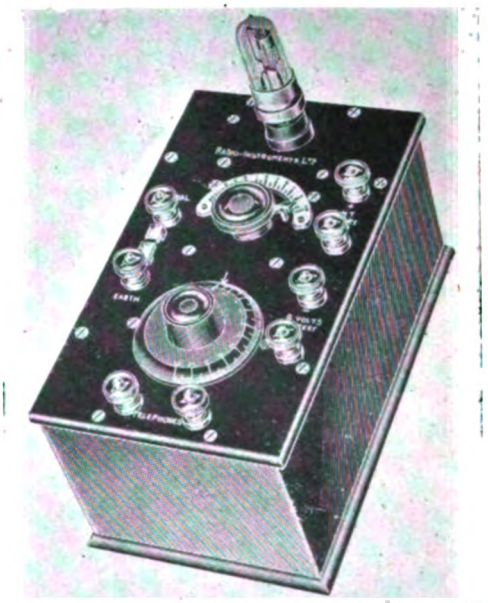
For the simpler types of broadcast receiver, such for example as the crystal receivers, where great mechanical rigidity and extreme constancy of calibration is not required, a very compact form of condenser has been devised.

*Self-contained 4-valve amplified receiver for broadcast reception, by Radio Instruments, Ltd.*

This variable condenser has a mica dielectric which enables comparatively large capacities to be contained in a very small space.

An apparatus of special interest which is also exhibited, is a device for enabling the ordinary house electric lighting wires to be used as radio receiving aerials. In the ordinary way it is not possible to utilise the house wiring as a receiving aerial without first switching off the current at the main switch where it enters the building, as otherwise a short circuit would result and the receiver would be damaged. The use of the "Ducon" attachment obviates this. It is tested to withstand 2,000 volts so that perfect safety is assured with no possible risk of shocks when handling the apparatus with the current switched on. The attachment is designed for inserting directly into an electric lamp-holder and is provided with terminals for attaching a wire to the aerial terminal of the receiving apparatus.

Various other patterns of standard laboratory condensers and condenser units suitable for



*Complete single valve amplifying receiver for broadcasting on Stand 37.*

both spark and C.W. wireless transmitters are also exhibited, the latter including a standardised condenser unit enclosed in an aluminium case, which can be employed for many patterns of transmitting equipment. This unit is fitted with a special type of mica terminal and can be used on circuits of which the voltage does not exceed about 10,000.

The patented construction adopted in the manufacture of this condenser ensures constancy of capacity and very low losses, even when carrying considerable high frequency currents.

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**Radio Instruments, Ltd. (Stand No. 37).**

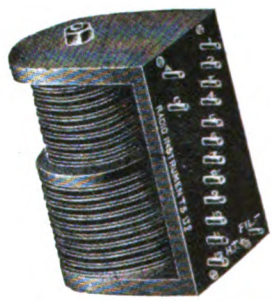
Residents in flats, hotels and places where the erection of a wireless aerial is out of the question, will be interested to learn that a complete wireless receiving set enclosed in a cabinet without any external wires or connections of any kind has now been designed by the above firm, and is exhibited at their stand. The receiver illustrated here comprises a 7-valve set with a frame aerial

*Frame Aerial Cabinet Receiver.*

fitted to the lid of a cabinet of period or other design in which is included a powerful loud speaker, and the necessary high and low tension batteries, the latter being accommodated in a cupboard in a lower part of the cabinet. To receive broadcast telephony, it is only necessary to open the lid of the instrument and to manipulate three knobs which control the tuning circuits, when music can be heard in a large room by a number of people. Doors are fitted to the loud speaker which can be opened or closed thereby reducing or increasing the sound as required.

Three specially designed high frequency intervalve transformers, fitted with tapping points on the windings and controlled by a coupled switch for simultaneous operation, are connected with the first three valves; the fourth valve acting as a detector, the last three valves being coupled through audio-frequency transformers, which are free from distortion so that the resultant magnified signal or speech is loud and clear. The frame or aerial coil fitted in the lid is hinged so that it can swing through an angle of 90 degs. for obtaining the maximum volume of sound according to the direction of the transmitting station.

The manufacturers inform us that a series of tests were recently carried out with the instruments fitted in a motor car while broadcasting was in operation, and the results



*H.F. Transformer 150/30,000 metres, with 12 tappings.*

observed with varying distances from transmitting stations. At 20 miles distance the music was quite clear, but much weaker than 10 miles distance, at which latter distance the music could be heard quite comfortably in the car. In London the volume of sound was sufficient to be heard outside the car.

The erection of an external aerial has undoubtedly prevented many people interested in wireless from installing a set. This objection has now been entirely overcome by this cabinet set.

Other apparatus exhibited by this firm includes 1, 2, 3, 4 and 7-valve sets complete with tuners and self-contained in one case, and crystal receivers of variometer type.

High frequency amplifying units, condensers, a loud speaker, and telephones of a new type are included amongst the accessories shown.

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# Experimental Station Design

(*Continued from p. 795, September 16th, 1922*).

*These articles, which appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the Experimental Station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions are given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.*

*Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.*

*The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony, and consequently may cover ground already familiar to many readers. The succeeding instalments, however, advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.*

## XIII.—SINGLE VALVE H.F. REACTING AMPLIFIER.

### AN AMPLIFIER ARRANGED TO ELIMINATE INTERFERENCE BY RADIATION.

FOR a good range, or for reception from low power stations, it is necessary to employ at least one stage of high frequency amplification. The unit to be described is intended for adding to a detecting valve set, which may already be arranged with a reaction coil coupled to the aerial circuit and followed by one or more note magnifiers.

A view of the top of the instrument is shown in Fig. 1, in which all essential dimensions are given. The panel is sawn from a sheet of $\frac{5}{16}$-in. ebonite and all edges filed true and square to one another and exactly square to the front face. They are finished by carefully sliding the panel edgewise along a piece of fine emery cloth, nailed down

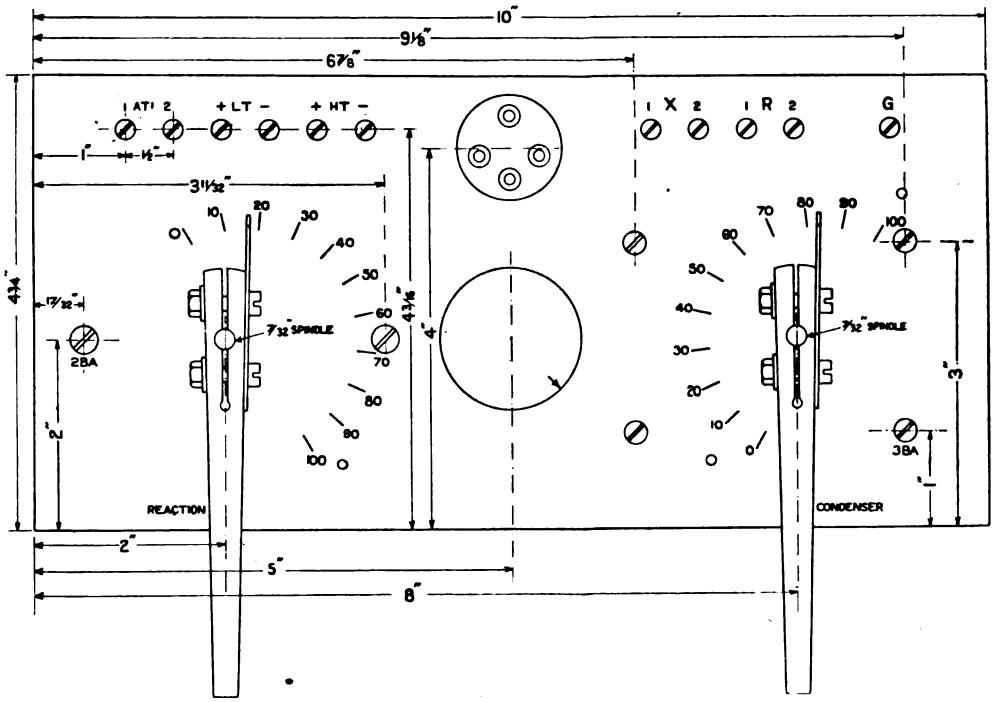


*Fig. 1. Lay out of panel of H.F. Amplifier. The lever on the left will be replaced by a knob, if a sliding instead of revolving inductance is fitted to provide tighter reaction coupling. Half full size.*

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to the bench, keeping the panel at exact right angles to the face of the bench and exerting even pressure along the edge.

Before drilling the panel the reader must bring together any pieces of apparatus already made up which he proposes to incorporate in the set. He will require a variometer, loose coupler, or any arrangement of two formers that will provide a variable coupling, an air dielectric variable condenser having a maximum value of about 0·0004 microfarads, a variable filament resistance, a valve holder and terminals, wire, "sistoflex" insulating sleeving and miscellaneous screws.

Holes for attaching the filament resistance and valve holder can be made equidistant from the ends.

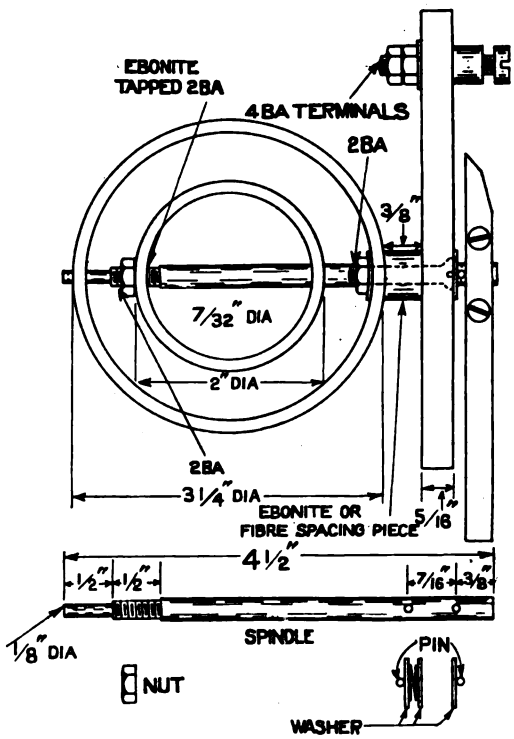


*Fig. 2. Constructional details of revolving type variable coupling. End view.*

The condenser shown in the figure is one the construction of which has been given in a former article.* It is attached by means of four 3BA screws and may consist of about one-third the number of plates shown in the illustration explaining its construction, provided the thickness of the plates and spacing washers are the same as those given. The capacity in microfarads for any condenser of other dimensions, can be found by multiplying the area of one side of one of the moving

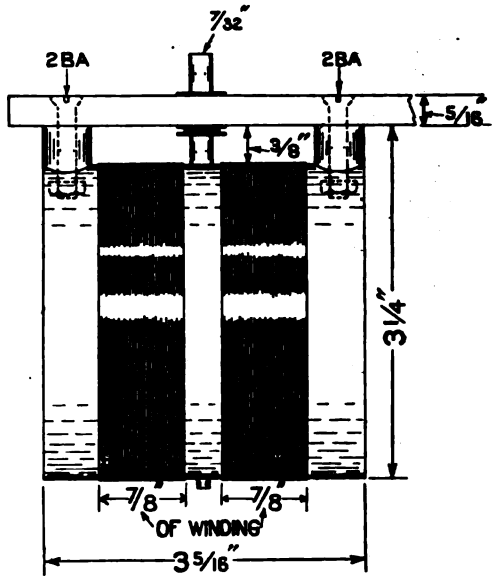


*Fig. 3. Side view, showing arrangement of the inductance which is in the plate circuit of the H.F. valve.*

plates (less the ineffective portion in the centre which is not overlapped by a fixed plate when in use) expressed in square centimetres by 1,768 times the number of moving plates and dividing this figure by the distance between the plates (that is, the thickness of the spacing washers less the thickness of the moving plates, and dividing the remainder by two), expressed in millimetres. The result obtained is divided by 1,000,000,000.

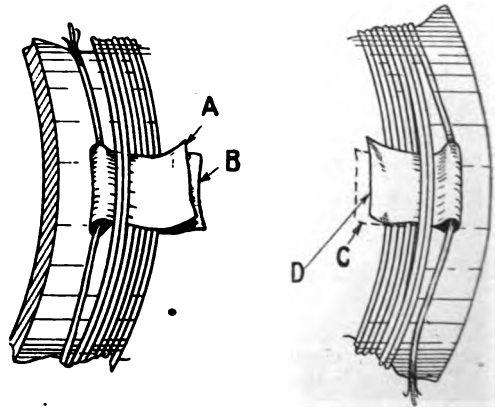


*Fig. 4. Method of terminating inductance windings.*

* Page 581, August 5th, 1922.

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The variable reaction coupling is arranged at the other end of the panel, the controlling handle of which balances out in appearance that of the condenser. One form of construction is shown in Figs. 2 and 3. A piece of 3¼-in. external diameter ebonite tube is obtained with a wall thickness of from ⅛ in. to $\frac{5}{32}$ in. and is carefully sawn to length, taking great care by sawing to pencil lines that the ends are true, and avoiding fracture while cutting. The ends are finished by rubbing on the piece of emery cloth which is nailed down to the bench. This tube is attached to the panel by means of two 2 BA brass screws with countersunk heads and 1¼ ins. in length. Ebonite spacing pieces fit over the screws to hold the coil away from the panel. These pieces have an external diameter of ½ in., a hole diameter of $\frac{3}{16}$ in. to ¼ in., and are ⅜ in. in length. One end of each piece is filed away to a hollow shape to fit the cylinder. The reader is again warned that great care is necessary in working big diameter ebonite tube owing to its liability to snap. The drill used for making the holes for the 2 BA screws and spindle must be put through slowly and without excessive pressure. The hole for the larger end of the spindle gives clearance, the actual bearing for this end being the panel.

The inner cylinder is cut from a piece of 2-in. tube and is 2 ins. in length. Holes are made in opposite sides at the exact centre point, one to exactly fit the $\frac{7}{32}$-in. spindle and the other a $\frac{13}{64}$-in. hole suitable for tapping to 2 BA. The spindle, also shown in Fig. 2, is made from a piece of $\frac{7}{32}$-in. brass rod. If $\frac{7}{32}$-in. is not easily available, ¼-in. rod may be used. One end is reduced in size, as shown in the diagram, for tapping to 2 BA and for providing a bearing. If a lathe is not available the diameter can be reduced by filing, as described in the earlier article on condenser construction.

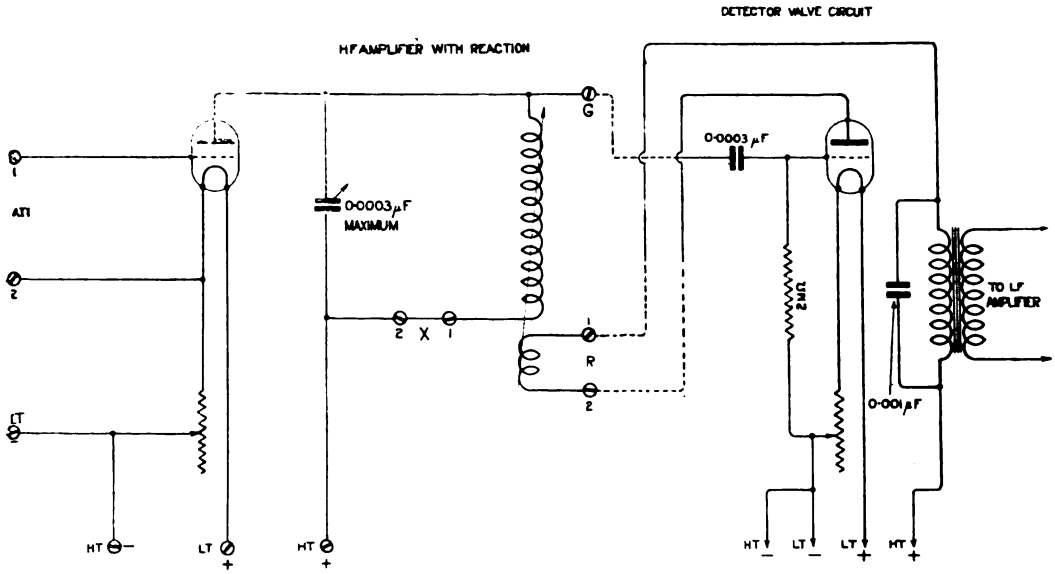


*Fig. 5. Circuit diagram of reacting amplifier connected to the detector valve. The terminals marking "A.T.I." on the left are for connection to the secondary inductance or former reaction coil, coupled to the aerial circuit.*

Two small holes are drilled through the spindle to carry pins made from about 18 gauge hard brass wire. The exact spacing of these holes must be determined, as the dimension given in the diagram only applies when a particular size of split washer is used.

In fitting up the formers the smaller one is adjusted to a central position and held by means of a lock nut. It is essential in making this component that the holes in the formers which carry the spindle are exactly opposite to one another. An easy way of ensuring this is to mark the positions for the holes by standing the cylinders on squared paper so that one of the lines becomes a diameter and extending this line vertically up the opposite faces.

The larger former is wound with two

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sections, each $\frac{7}{8}$ in. in width, of No. 20 D.C.C. wire. The few turns required are, of course, put on by hand, even though the reader may possess a lathe, as the wire is rather stiff. The method of fixing the ends of the wire is shown in Fig. 4. Three pieces of strong silk ribbon, $\frac{3}{4}$ in. in width, are laid on the former at equal distances around it. One turn of wire is then passed round over the three pieces and they are then bent back as shown in "A." Two more turns of wire, quickly and roughly put on, will hold the ribbons in place sufficient to secure the first turn. By pulling on the end "A" the first turn can be brought down in contact with the second turn and the three turns pushed up into position. Tension must of course be kept on the wire the whole time and the beginning end can be bent back to prevent it slipping through the loop in the ribbon. The end "B" is buried under subsequent turns. When the winding has progressed to within about $\frac{1}{2}$ in. of the required distance to which the coil is to be wound, three more ribbons are laid on the former so as to secure the ends "C." The full number of turns are then put on and the wire cut to length. Three or four turns are then unwound, taking care not to allow the whole winding to run slack. All except one turn are then wound on again, this time over the ribbon and securing down the ends "D." The last turn is tucked through the loops and by pulling on the ends "D" is brought down into position.

The smaller coil is wound with No. 26 D.C.C. in two sections, each $\frac{3}{4}$ in. The end turns are secured in the manner just described. Flexible wires are soldered to the ends and must be given two or three turns round the spindle and passed on for connecting in the circuit, either through one end of the large former or through two holes made between the two sections of the outside winding, and on either side of the spindle.

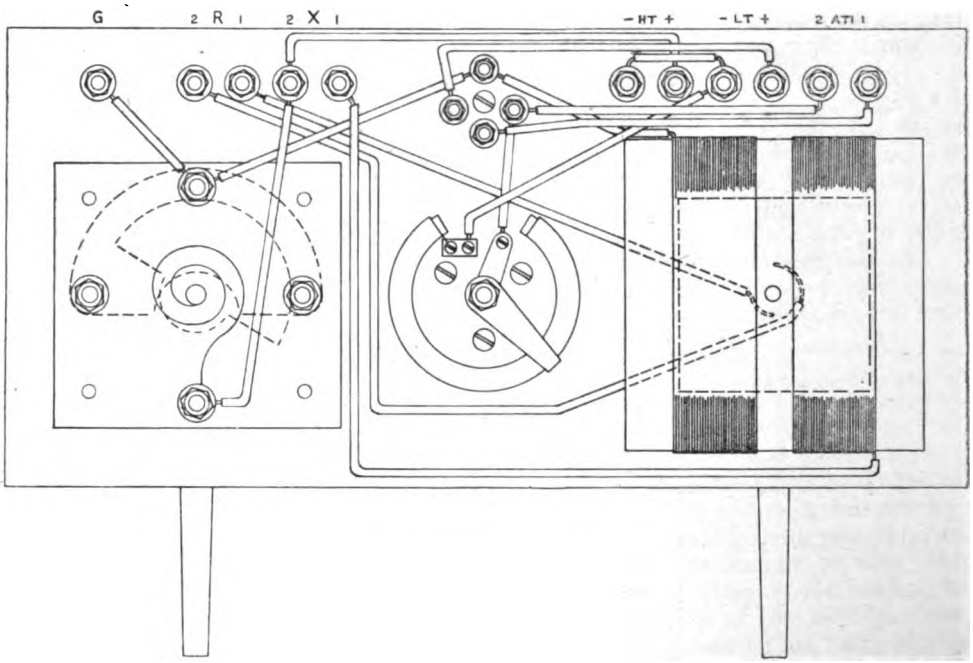


*Fig. 6. Wiring diagram. Certain varieties of valves require tighter reaction coupling, which can be obtained by substituting a sliding inductance for the revolving pattern shown on the right. Half full size.*

If preferred, coupled coils may be built up to the design given for a high-frequency intervalve transformer with coupled reaction. Only one winding will be required on the outside former, which should consist of 44 turns of No. 24 D.S.C. wire, occupying $1\frac{1}{8}$ in. The inside former should be wound full with No. 34 enamelled or S.S.C. wire.

This arrangement is most convenient to operate and does not burst into oscillation with small changes of adjustment. At a position of medium coupling a very high

* Page 718, September 2, 1922.

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degree of amplification is obtained, entirely free from any tendency to howl.

The windings given are suitable for reception on wavelengths of 350 to 550 metres. For longer wavelengths finer wire may be used for winding the inductances, or the turns can be pile wound.

The components are assembled on the panel as shown in Fig. 1. The levers are of a type already described and the scale lines marked on the top of the instrument must be slightly staggered in order that the pointers may lie along them. The scales may be either scratched on the ebonite or carefully drawn on paper and pasted on. It is better, of course, to have the scales and other labelling engraved and this can easily be arranged by carefully marking all labelling exact as to size and position in pencil and putting the panel in the hands of a firm undertaking this class of work. The faces of the panel should be carefully rubbed down as previously described, with very fine emery paper before assembling.

The wiring diagram is given in Fig. 5, and shows the H.F. amplifying unit coupled to the detector valve, which was formerly the first valve in the receiving set. It is to be noted that the grid leak is not connected across the grid condenser. For the guidance of those not familiar with the wiring up of instruments, a practical wiring diagram is given in Fig. 6.

Using this amplifier with an "R" type valve, the coupling provided by the turning inductance is usually sufficient to give reaction effects, and produce amplification. With "V 24" valves, which are specially designed for high frequency amplification, the sliding method should be adopted in order to produce sufficient coupling. The amplifying unit, when used on short wavelengths, will give a marked degree of amplification and by its use the experimenter can be sure that he is causing no interference with neighbouring stations.

F.H.H.

# A French Wireless Exhibition

AN exhibition of wireless apparatus has recently been held in Paris as a section of the Concours Lepine. The majority of the French manufacturers of amateur radio apparatus and accessories were represented, and had on show a number of interesting instruments.

Apart from complete sets, amplifiers, etc., of the usual types, attention appeared to have been devoted largely to the construction of many novel forms of frame aerial for indoor reception, in which the actual loop wires were concealed in the parts of articles of furniture.

Several arrangements of unit systems were exhibited, some being of fairly conventional type in polished wood boxes, but others being of much smaller size and forming very neat receiving sets when coupled together. By the use of these devices, in conjunction with concealed frame aerials, the installation of a receiver for broadcasting becomes an extremely simple matter.

P.R.C.

# The Position of the Grid Leak

IN sets which employ the leaky condenser method of rectification the position of the grid leak has a considerable bearing upon the quality of the results obtained. Among amateurs of experience the practice is increasing of connecting the leak direct between the grid and one end of the filament, and this position has much to commend it. In the case of reactance—or resistance—capacity coupling it is of course essential. To which end of the filament the leak is to be connected is a matter of some importance, and depends upon the valve used; a few valves seem to work equally well to whichever end it is connected, but the majority have a definite right and wrong position, negative in some cases and positive in others. Hence, the experimenter should never be satisfied that his rectifier is doing its best until he has tried both. A desirable refinement on one's set is a single-pole two-way switch to enable one to make the change without altering the internal wiring each time.

G.P.K.

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# Progress in the Broadcasting Scheme.

## OFFICIAL STATEMENTS OF THE POSTMASTER-GENERAL AND OF THE MARCONI COMPANY

MANY statements have appeared in the general press with regard to the progress of arrangements for broadcasting since the Postmaster-General first gave his official sanction to the consideration of such a scheme in this country.

It has been realised by this Journal that this subject is one of the utmost importance and interest to all readers, and some impatience may have been felt at the absence of any detailed announcements of progress in this Journal. The reason for the absence of announcements up to the present time is a simple one, there having been no announcements to make which could be regarded as being in any way comprehensive or marking any definite step in progress towards the realisation of the broadcasting scheme.

The position to-day is, however, different, a real advance having been made, as indicated in the following official statement, made within the last few days by the Postmaster-General:

"A conference took place on September 12th between the Committee of Manufacturers and representatives of the Postmaster-General in regard to the criticisms which he has had occasion to make on the articles of association of the proposed broadcasting company, and on the terms of the proposed agreement between the company and the firms who will constitute its individual members. Several of the points raised by the Postmaster-General were satisfactorily met, and in two or three cases in which the Committee felt unable to accept his views they made alternative proposals. These have led to agreement in principle, and, so far as the Postmaster-General's criticisms are concerned, it only remains for his representatives and the Committee to settle certain details.

"It appeared at the conference that, apart from the Postmaster-General's criticisms, there were differences between members of the Committee themselves, which would have to be settled before the broadcasting company could be formed. It is understood, however, that considerable progress has also been made towards the solution of these difficulties.

"It was agreed at the conference that, as soon as a settlement had been arrived at in regard to the above matters, the Committee of Manufacturers should call a meeting of all the firms who desire to join the broadcasting company (who, it will be remembered, must be *bona fide* British manufacturers), at which the whole situation will be explained to them.

"In the meantime, the Postmaster-General and the Committee desire it to be known that membership of the broadcasting company will not, of itself, entitle a member to use the patents of other members in the manufacture of receiving apparatus. In particular, the Marconi Company claim to hold patents which are necessary for the construction and use of "valve" receiving sets. The company have stated that they are prepared to allow members of the broadcasting company to use these patents on terms which can be obtained on application."

In addition, the Postmaster-General states that he proposes to withhold until the definite formation of the broadcasting company the issue of the simple form of licence for broadcast reception.

This delay in the issue of *broadcasting* licences is not to hamper the issue of experimental licences which are still being issued to all who satisfy the Postmaster-General that they have a sufficient knowledge of wireless to enable them to make proper use of the licences granted.

This attitude of the Postmaster-General towards the issue of *experimental* licences is one which can hardly be regarded with satisfaction by amateurs and experimenters generally. In the past it has been customary to issue licences to conduct experiments in wireless telegraphy without it being necessary to satisfy the Postmaster-General as to any special scientific qualifications or previous wireless experience. The Wireless Society of London especially, is taking up the cause of the amateur in this connection, and it is to be hoped that the considerate hearing which the Postmaster-General has always given to the expression of opinion made by wireless amateurs and

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experimenters as a community, through the channels of the Wireless Society of London, will result in a modification of these unsatisfactory restrictions to amateur activities.

But to return to the subject of broadcasting and the progress made. Since, in the announcement of the Postmaster-General's referred to above, special reference is made to the attitude of the Marconi Company with regard to patents and the construction of valve receiving sets involving the use of patents of this company, this Journal sought out an official of the Marconi Company, Colonel Adrian Simpson, and was able to obtain a statement which puts clearly the position of the Marconi Company with regard to their patents.

The following is the text of the statement made officially by Colonel Adrian Simpson, Deputy Managing Director of the Company.

> "In order to facilitate the formation of the British Broadcasting Company, Ltd., which will hold the Postmaster - General's licence for the conduct of the broadcasting service in Great Britain, my company has agreed to give to the British Broadcasting Company the free use of its patents for the purpose of erecting the necessary stations throughout Great Britain. Furthermore, my company has agreed to give to any *bona fide* British manufacturer who becomes a member of the Broadcasting Company a licence to use the Marconi patents for the purpose of manufacturing broadcasting receivers. Such receivers have to be of an approved type and conform with certain technical stipulations laid down by the Postmaster-General. A large number of the leading manufacturers have already approached my company and have accepted a licence. Full details regarding the terms on which these licences will be granted may be had by any *bona fide* British wireless manufacturer on direct application to my Company."

From an authoritative source, this Journal has been informed that only one or two minor points still remain to be settled before the Postmaster-General will be in a position to approve the Articles of Association of the Broadcasting Company. The moment that these Articles of Association have been approved, broadcasting will commence, and this Journal has good grounds for believing that it is now only a question of days before broadcasting in this country will become an established fact.

# Notes

## Broadcasting by the Prince of Wales.

His Royal Highness the Prince of Wales has graciously consented to "broadcast" by wireless telephony from York House through Marconi House **2 LO**, London, on the evening of October 7th, an Address to the Boy Scouts of Great Britain. This Address will be specially directed to those scouts who for various reasons are unable to be present in the afternoon of that day, at the great Rally being held in his honour at the Alexandra Palace, London.

The Prince will speak by wireless between 7.30 and 8 p.m., the Marconi House wavelength being 360 metres.

In order that a maximum number of scouts may listen-in on this occasion special arrangements are being made with the Wireless Societies throughout Great Britain whereby they place their services at the disposal of local troops.

## Railway Experiments.

A system of transmission of telephony on electric trains has been experimented with in America. Messages are transmitted electrically, partly over a wire and partly through space. The experiments which were conducted by wireless engineers and representatives of four railways, were carried out at Schenectady. Efforts were made to communicate from a moving train to a sub-station three miles away. The trolley wire, carrying current to the electric engine or trolley car, was used as a carrier of telephone communication by means of another current of different frequency, which was superimposed on the wire.

This was the first demonstration, says *Practical Engineer*, of the application of "carrier current" communication to the problem of communicating between the head and rear ends of long goods trains, or to expedite train operations held up by faulty block systems.

## Expansion of Service between America and Europe.

As stated in our issue of September 23rd, a new service has been opened in America of acceptance of messages at telegraph and cable offices for transmission by the Radio Corporation Company.

The Radio Corporation of America announced that an agreement had been signed between that company and the Postal Telegraph-Cable Company whereby every office of the Postal Company in the United States becomes an agency of the Radio Corporation for the acceptance of radiograms for transmission across the Atlantic Ocean and for the delivery of radiograms received from overseas for points in the United States.

This important linking up of radio and wire line services reflects the rapid growth of the Radio Corporation's overseas telegraph traffic since the return of its high power stations by the Government after the close of the Great War.

These stations transmit and receive radiograms directly to and from England, France, Norway and Germany, and through connecting stations abroad, to and from all countries in Europe, Asia and Africa.

D

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The contract just signed gives to the inland commercial centres and the thousands of small points reached by the postal system equal facilities with those now enjoyed by the eastern cities mentioned, the Postal Telegraph Company performing the same service for radiograms of the Radio Corporation of America as it does for cablegrams to be transmitted by submarine cable.

With the coming development of high speed wireless telegraphy the new arrangement will permit the Radio Corporation of America to carry out its plans for the inauguration of a low rate plain language radio letter service to and from all points in the United States and Europe.

It will be remembered that the Radio Corporation of America is the outgrowth of the Marconi Company of America.

**Communication in Mines.**

Interesting results were obtained by Birmingham experimenters at the Baggeridge Colliery a few days ago. Efforts were made to transmit messages from a depth of 700 yards to the surface. A three-valve set was used. The aerial was erected by slinging a wire from a steel hoisting gear 100 feet high to a girder of a railway bridge. The earth wire was clamped to the lower part of a railway rail. At first the transmitter and its aerial were installed in the steel cage, but considerable screening effect was experienced. Tests were made at various distances down the shaft, and reception was found to be clearer when transmission was made at the lower points. This was thought to be due to absence of structural steelwork, which might have caused screening higher up. Another experiment was made by taking the transmitter along the workings and earthing was effected by bringing a length of cable along the floor. The aerial was slung between pit props. Signals were clearly received at the pit mouth, although owing to limited power of the transmitter telephony was weak. It was suggested that the carbon in suspension in the air was having an absorbing effect on the signals.

# Calendar of Current Events

**Friday, September 29th.**

WIRELESS SOCIETY OF HIGHGATE.

At Highgate Literary and Scientific Institute, South Grove, Highgate, N.6. Annual General Meeting, Election of Officers, Annual Report, etc.

BELVEDERE AND DISTRICT RADIO AND SCIENTIFIC SOCIETY.

Lecture on "Oscillatory Circuits," by Mr. A. G. Warren, M.Sc.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

At Brook Lodge, Ravenscourt Park, W.6. Lecture by Mr. F. E. Studt on "A Three-Circuit Variometer Tuner."

**Saturday, September 30th.**

Opening of First All-British Wireless Exhibition, to be held at Horticultural Hall, Westminster, S.W.1. Closing date, October 7th. Open daily, 10 a.m. to 10 p.m.

**Sunday, October 1st.**

*Daily Mail* Concert from The Hague, **PCGG**, 8 to 9 p.m. B.S.T., on 1,085 metres.

**Monday, October 2nd.**

ILKLEY AND DISTRICT WIRELESS SOCIETY.

At 8 p.m. at Regent Café. Morse practice.

**Tuesday, October 3rd.**

Transmission of telephony at 8 p.m. on 400 metres by **2MT** Writtle.

GREENWICH WIRELESS SOCIETY.

At 7.45 p.m. At Rangers House, Blackheath. Ordinary Meeting.

**Wednesday, October 4th.**

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION.

Lecture on "Portable Receivers," by Mr. Donkin.

WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Gadgets" Competition.

WIRELESS SOCIETY OF EAST DORSETSHIRE.

At Branksome Liberal Club, Salisbury Road, Upper Parkstone. At 7 p.m. Formation of Winter Programme. First Lecture on "Construction of Single Valve Receiver."

**Thursday, October 5th.**

*Daily Mail* Concert as above.

GLASGOW AND DISTRICT RADIO CLUB.

At 200, Buchanan Street. First Ordinary Meeting of Winter Session. Ballot for Membership.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.

At 8 p.m. At H.Q., The Council House, Treaty Road, Hounslow. Lecture on "Wireless for the Man in the Street," by Mr. S. H. Nayler.

**Sunday, October 8th.**

*Daily Mail* Concert as above.

**Monday, October 9th.**

ILKLEY AND DISTRICT WIRELESS SOCIETY.

At 7.30 p.m. At Regent Café. General Meeting, followed by lecture on "Capacity and Condensers," by Mr. E. Stanley Dobson.

**Tuesday, October 10th.**

Telephony by **2MT** Writtle as above.

RADIO EXPERIMENTAL ASSOCIATION. (NOTTINGHAM AND DISTRICT.)

First Meeting in new H.Q.

**Wednesday, October 11th.**

REDHILL AND DISTRICT Y.M.C.A. WIRELESS SOCIETY.

At 111, Station Road, Redhill. Lecture on "Condensers," by Mr. Edwards.

PORTSMOUTH AND DISTRICT WIRELESS ASSOCIATION

Lecture on "Charging Accumulators by the Noden Valve off A.C. Mains," by Mr. R. Cole.

STOCKTON AND DISTRICT WIRELESS SOCIETY.

At 7 p.m. General Meeting.

**Thursday, October 12th.**

*Daily Mail* Concert as above.

**Friday, October 13th.**

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

At Stamford Brook Lodge, Ravenscourt Park, W.6. A popular lecture and demonstration of latest apparatus made by Messrs. Burndept, Ltd., by Mr. A. O. Gibbons.

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# Wireless Club Reports

*NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.* **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

### Wireless and Experimental Association.*

Hon. Secretary, Mr. Geo. Sutton, 18, Melford Road, S.E.22.

The meeting of the Association at the Central Hall, Peckham, on Wednesday, 23rd inst., was marked by a good attendance and quite an eagerness of the amateurs present to put up and discuss the little difficulties which they had encountered in their experiments since the last meeting. It was to have been a wireless "gadget" night, with a competition for a prize offered by the Chairman, but so few gadgets materialised that an extension was made for the event to take place on October 4th.

A member had sent in a communication descriptive of the methods of staining and finishing the woodwork of home-made apparatus, but when read, it was found to be less helpful than had been hoped. The Secretary stepped into the breach, and starting off with the dictum that "the whole art of French polishing lies in the knowledge of when to leave off rubbing," gave the meeting the benefit of his somewhat extensive experience. Questions put, and other experiences detailed, showed that the chat had served the purpose intended.

Quite a lot of business was done in the matter of the rumoured threats to the amateur's liberties, and the Secretary was further instructed.

### The Finchley and District Wireless Society.

Hon. Secretary (*pro tem.*), Mr. A. E. Field, 28, Holmwood Gardens, N.3.

The first meeting of the above Society was held at Squire's Lane Schools on Wednesday, September 13th. The following elections were made:—Chairman, Mr. Trussler; Treasurer, Mr. Smith; Secretary, Mr. Field; and Committee, Mr. Bishop, Mr. Macdonald Brown, Mr. Storey, Mr. Cooper, Mr. Turner and Mr. Campion. The future meetings will be held on Monday evenings at 8 o'clock.

Twenty-eight members were present. A number of suggestions were proposed, many of which were accepted. At the close of the meeting, the Committee met, when rules and subscriptions were decided upon. It is hoped that all amateurs in Finchley and district will become members; full particulars can be obtained from the Secretary.

### Stoke-on-Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of this Society at the Y.M.C.A., Hanley, on Thursday, September 14th, it was announced that permission had been received from Mr. Wenger to allow the members to use the roof of the Mecca Café building for the purpose of erecting an aerial.

Signals were received from several stations on the Society's single valve "Mediwaver" set, only using a frame aerial inside the club-room.

Mr. A. Hackney (member) continued with his series of lectures on the construction of wireless apparatus. He demonstrated a new method of winding inductance coils for tuners, to receive the transmissions sent out on short wavelengths by the broadcasting stations and wireless amateurs holding transmitting licences. A sample coil was constructed and exhibited.

Members who have wireless receiving sets that are not giving the expected results are invited to bring them along to the club-room on Thursday night, when they can be tested and faults cleared.

### Liverpool Wireless Society.*

Hon. Secretary, Mr. C. L. Lyons, 76, Old Hall Street, Liverpool.

A meeting of the above Society took place at the Royal Institution, Colquitt Street, Liverpool, on Thursday, September 14th.

A demonstration was made of the Society's instruments, Mr. C. G. Williams explaining the C. Mark III three-valve amplifier.

The question box was then sent round and a very interesting batch of questions resulted, which Mr. N. D. B. Hyde dealt with in his usual lucid manner, illustrating his explanations with very clear blackboard diagrams.

Mr. F. P. Owen next demonstrated to the Society a very compact portable receiver, consisting of both crystal and single valve detector. This instrument was entirely home-made, including the outer case, switches, tuning coils, telephones, etc., and every item, including the L.T. and H.T. batteries, were housed in the one outer case. Although operated in conjunction with the Society's indoor aerial, signals were received on the valve detector. A vote of thanks was passed in favour of Mr. Owen, and the members were invited to bring along for demonstration at any subsequent meeting home-made apparatus of the same nature.

Mr. J. Coulton, who has been prominently associated with the Society for many years, gave a short address. All regretted to learn that Mr. Coulton has found it necessary to leave Liverpool for London for a considerable period, possibly for good. Mr. Coulton was elected the Society's accredited representative whilst in London.

Another meeting was held at the same address on Thursday, September 28th.

The first meeting of the winter session will be held on Thursday, October 12th, at the Royal Institution, Liverpool, when Professor E. W. Marchant, President of the Society, will deliver an interesting address.

### Glasgow and District Radio Club.*

Hon. Secretary, Mr. E. Robert Carlisle, 40, Walton Street, Shawlands, Glasgow.

This Club resumed its activities with the Annual General Meeting which was held at the club's new premises, 200, Buchanan Street, on Wednesday, September 27th. At this meeting the election



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of office bearers, etc., was carried out in accordance with the rules. Owing to pressure of private business the President and Hon. Secretary did not offer themselves for re-election, but suitable candidates for these posts were nominated by the Committee. There were some twenty-seven names before the Committee as candidates for membership, and these will be balloted for at the first ordinary meeting on Thursday, October 5th.

The club has arranged for a public exhibition and demonstration of wireless reception at the McLellan Galleries Hall, Sauchiehall Street, on Saturday, November 4th. The Exhibition will commence at 12 noon, and will continue till 9 o'clock p.m. The Committee hope to have a collection of both ancient and modern wireless apparatus, and trade firms who wish to be represented should send full particulars of offers to the Hon. Secretary as soon as possible. Two aerials will be available.

Professor G. W. O. Howe, D.Sc., M.I.E.E., has kindly consented to deliver an address at 3 o'clock p.m., and special messages from continental stations have been arranged for.

Tickets for admission are 1s. each (including tax), and can be had from all club members and the principal wireless dealers in Glasgow.

A syllabus for the ensuing season is in the course of preparation, and the Secretary will be glad to have the name of any gentleman who can give a lecture or otherwise contribute to the winter's programme.

### Hounslow and District Wireless Society.*

Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow, Middlesex.

Asst. Secretary, Mr. J. H. Donithorne-Clark, "Lorraine," Argyle Road, Hounslow.

A meeting of the above Society was held on Thursday, September 7th, 1922, at the Council House, Treaty Road, Hounslow, the President, Mr. A. R. Pike, in the chair. On the Committee's recommendation it was decided to devote half-an-hour on alternate meeting nights to Morse practice in accordance with the wishes of a large section of the members who are extremely anxious to increase their speed. The following members were also elected to form an entertainments sub-committee to relieve the general committee from the work entailed in organising fêtes, public demonstrations and other social engagements which the Society purposes holding during the forthcoming winter months:—Lieut. Walker, Messrs. Blakeley, Clark (Asst. Secretary), Fletcher, Ladley and Myland, with the President and Secretary *ex officio*. The Society has also in the course of preparation its syllabus of lectures, and in addition to lectures by the more advanced members on general meeting nights, the following dates have already been booked:—Lieut. Walker, October 19th and November 23rd, 1922; January 18th and March 8th, 1923.; Mr. S. H. Nayler, October 5th, "Wireless for the Man in the Street," November 9th, "Wireless for the Beginner," December 14th, "Valves for the Beginner," January 4th, "Wireless—Pastime and Profession," February 15th, "Hints for the Teacher and Student of Wireless," March 29th, "The Ideal Wireless Man: His Character and Training."

At a further meeting of the Society on September 14th, at their headquarters, Mr. A. R. Pike in the chair, a most enjoyable evening was spent. In addition to a large number of new members being accepted, the Society had the pleasure of welcoming Mr. Fellows, of the "Fellows Magneto Co., Ltd.," as a Vice-President. He expressed his intention of assisting the Society in every way he could, and before leaving handed to the Treasurer ten guineas as an expression of goodwill. Lieut. Walker, also a Vice-President, then rose to address the meeting, stating that it was his intention to roughly explain some of the points which had recently been before the Committee. He described the necessity for an entertainments sub-committee, to which he strongly urged the members to bring their ideas. He explained to new members why arrangements for the working, etc., of the Society were submitted to the general meeting, the possibilities of amateur transatlantic transmission, and the still greater necessity for Morse practice. The rest of the evening was taken up with the demonstration of a portable set made by a member, Mr. Marchant, and included reception of telephony *via* the local Council's power mains.

The Secretary will always be pleased to receive applications for membership from any lady or gentleman.

### The West London Wireless and Experimental Association.*

Hon. Secretary, Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

The meeting held Thursday evening, September 14th, was well attended.

Mr. O. S. Puckle, of the Wireless Society of London, gave a lecture entitled, "The Less Known Forms of Telephone Receivers." This proved to be a deep and interesting subject. The lecturer divided telephone receivers into four sections, and in turn sub-divided each section upon which he gave a very fine detailed description as to their functions and results forthcoming from various experiments carried out by himself and others that he had seen made.

At the termination of the lecture Mr. Puckle was accorded a very hearty vote of thanks. Questions were then asked and replied to fully.

By the kind permission of Major A. S. Angwin, D.S.O., M.C., the club meetings will in future be held at Stamford Brook Lodge, Ravenscourt Park, W.6., close to Stamford Brook (District Railway) station, and furthermore the weekly meeting night will now be held on Friday evenings, from 7.10 p.m. instead of Thursdays. It is hoped that the members will support the Committee's action, as undoubtedly the better accommodation and facilities offered will give the association better results. The Secretary will be glad to give full particulars of the association on application.

Forthcoming events include: September 29th, Mr. F. E. Studt, "A Three-Circuit Variometer Tuner." October 13th, Mr. A. O. Gibbon, of Engineer-in-Chief's Dept., G.P.O., A popular lecture and Demonstration of Latest Apparatus made by Messrs. Burndept, Ltd.

### Belvedere and District Radio and Scientific Society.

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

At the Erith Technical Institute on Friday, September 15th, Mr. A. G. Warren, M.Sc., addressed

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the weekly meeting of the above Society on "The Scope of Wireless." He mentioned that wireless, although in its infancy, was changing so rapidly that if one tried to construct the latest receiving apparatus it may be out of date before completion.

The speaker mentioned it was unfortunate that during his student days too little attention was paid to electrostatics, as this is the branch of the electrical science most in keeping with present-day wireless.

The President, in thanking Mr. Warren for his most interesting and instructive paper, remarked that in his early days he considered electrostatics, with its pith balls, etc., a confounded nuisance, but he now saw the usefulness of its application in wireless phenomena.

### Plymouth Wireless and Scientific Society.

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devenport.

The second Annual General Meeting of the Society was held on September 15th. The reports of the Secretary and Treasurer, showing the Society to be in a satisfactory and flourishing condition, were adopted unanimously.

Election of officers for the coming year then took place with the following results:—Chairman, Mr. S. G. Monk, B.Sc., M.J.I.E.; Vice-Chairman, Mr. S. F. Heal; Hon. Secretary, Mr. G. H. Lock, A.J.I.E.; Assistant Secretary, Mr. P. Arbery; Treasurer, Mr. C. E. Harris; Librarian, Mr. W. Tregilgas; Committee, Messrs. L. Voss, L. Currah, S. F. Heal, H. J. George, H. F. Downes and Dr. E. McCulloch.

An Extraordinary General Meeting was called for Tuesday, September 26th to consider a complete revision of the rules.

Full particulars of the Society will be furnished on application to the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Devonport.

### Sutton Wireless Society.

Hon. Secretary, Mr. E. A. Pywell, "Stanley Lodge," Rosebery Road, Cheam, Surrey.

The Rev. F. C. Lees, F.R.G.S., F.R.A.S., has very kindly accepted the Presidency of the Society, and his expert knowledge of radio and kindred subjects is of considerable benefit to the members. The roll now stands at 26, and is steadily increasing. A two-valve set on the unit system is to be installed, and the Society has already been presented with an L.F. transformer and 0·0003 variable condenser.

On Saturday, August 26th, by the courtesy of the Controller of Communications, Air Ministry, a party of 16 spent an extremely interesting and instructive afternoon at the Croydon Aerodrome. The wireless transmitting and receiving gear was seen, and the working explained to the visitors by the engineers in charge.

The members greatly appreciated the cordial reception accorded them.

### The Fulham and Putney Radio Society.

Hon. Secretary, Mr. J. Wright Dewhurst, 52, North End Road, West Kensington, London, W.14.

At a meeting held on Friday, September 15th, which was well attended, several new members were admitted. Some of the members, notably Messrs. Hart-Smith, Winnett, H. A. Gardiner and Calver, offered the Society a collection of technical books, and it was proposed that a librarian be elected. Mr. S. W. Martin was elected to this post, and he will in due course notify the members as to the books available.

The Morse buzzer class was started on September 22nd, and is in charge of Messrs. Winnett and Calver. The Society is to be congratulated on obtaining the services of two such highly technical instructors who have very kindly placed their services at its disposal.

After the close of the business, Mr. Calver introduced Mr. Adams, of Wandsworth, the winner of Messrs. Selfridge's wireless competition. Mr. Adams had brought with him the apparatus which had won the prize. This consisted of a very small and compact three-valve set with specially wound transformers, and coils, the whole being well made and finely finished. The time being limited, Mr. Adams could not go into much detail of construction, but with the assistance of Mr. Barker, with batteries and accumulator, the members present heard some signals which were rendered very loud and clear due to the special winding and wiring of the set. Mr. Adams has very kindly promised to explain the set in every detail at a future meeting. A very hearty vote of thanks was accorded to Mr. Adams for his very entertaining hour and offer. Mr. N. A. Brown had with him a two-valve set, also very neat and compact, which was tried with very good results. After more promises from members of sets and parts for trial, the meeting closed.

Judging by the liveliness of the proceedings, and the interest displayed, the future of the Society is well assured.

### The Lowestoft and District Wireless Society.

Hon. Secretary, Mr. L. W. Burcham, "Gouzea-court," Chestnut Avenue, Oulton Broad.

The above Society opened the winter session on Tuesday last, September 12th, when a very good muster of members were present.

Before the meeting started, the members' attention was drawn to the fact that the Society were indebted to Messrs. Chipperfield, Ltd., Radio Engineers, of Oulton Broad, for the excellent four-valve experimental panel, which measures about 2 ft. × 1 ft. 6 in., presented to the Society by them. The set is very quiet in working and gives excellent results, especially with telephony. When the members were finally drawn away from listening to "Writtle," Mr. R. J. Hudson delivered his lecture on "Wheatstone Receivers," which was thoroughly enjoyed by all present. Questions were numerous, but the expert knowledge of the lecturer enabled him to satisfy all queries.

Through the courtesy of Mr. C. Garrood a small party of members spent a very pleasant afternoon on August 20th in a motor boat on the river Waveney. A three-valve set was taken out and an aerial erected between two trees. Excellent telephony, etc., was received during the afternoon and Marconi House provided an hour's entertainment after tea, much to the delight of some farm hands working in a hayfield close by, also various owners of craft cruising on the river.

The Society now meets every other week as from the 12th inst. There is still plenty of room at the club-room, St. Margaret's Institute, Alexandra Road, Lowestoft, for more members.

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**Leamington, Warwick and District Radio Society.**

Hon. Secretary, Mr. F. A. Sleath, 31, Archery Road, Leamington Spa.

The second general meeting of the above Society was held at the Spencer Street Schools on Thursday, August 24th with the Vice-President, Mr. G. H. Champ, in the chair. Mr. Marriott gave an excellent lecture on "Aerials and their Construction." The advantages and disadvantages of various types were dealt with, and methods of rigging up masts, spreaders, etc., explained. Mr. Champ operated one of his sets (two-valve), and some good results were obtained. The meeting terminated at 9.30 p.m.

The third general meeting was held on Thursday, September 7th, and in the absence of Mr. Hills, who was to lecture on the construction of a tuner, Mr. Sleath obliged with a few words on "Inductances," and explained the methods of winding various types. After discussion and questions on matters of interest, the meeting terminated at 9.30 p.m. Attendance at the last two meetings was poor. Any gentlemen in the district who are interested should communicate with the Hon. Secretary.

**Fulham and Chelsea Amateur Radio and Social Society.**

Hon. Secretary, Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W.6.

A meeting was held on September 13th at the Society's temporary headquarters, the minutes of the previous meeting being read and accepted.

It was proposed by Mr. Saunders and seconded by Mr. Patterson that the Society should apply to become affiliated with the Wireless Society of London, this being generally accepted, the necessary steps will be taken.

During a discussion on reception Mr. Whitts, a member, kindly gave a short but exceedingly interesting lecture on the ether, which was much appreciated. There was an attendance of 37, of whom two were visitors. The total membership is now 60. Ladies are especially invited.

**Swadlincote and District Radio Society.**

Hon. Secretary, Mr. H. Shakespeare, 46, High Street, Newhall.

Inaugurated but a week or two ago, the Society is making rapid progress and already the membership numbers over 30. A meeting was held on Wednesday, September 13th, in the Hastings Road Schools at 7.30 p.m., when a discussion took place on the rules, which were passed as framed at the first meeting. It is hoped to find suitable headquarters shortly. As to the apparatus, the decision of the sub-committee that the members construct their own was endorsed. Six new members were enrolled, and more will be welcomed.

**Wireless Society of Birkenhead.**

Hon. Secretary, Mr. R. Watson, 35, Fairview Road, Oxton, Birkenhead.

A Wireless Society of Birkenhead in conjunction with the Y.M.C.A. is under formation. Will all those in the Birkenhead district requiring particulars apply to the Hon. Secretary.

**Huddersfield Radio Society.**

Hon. Secretary, Mr. C. Dyson, 14, Y.M.C.A. Buildings, John William Street, Huddersfield.

A Society has been formed with headquarters at the above address. The following officers have been elected:—President, Mr. Tom F. Brook; Hon. Secretary, Mr. C. Dyson; Hon. Treasurer, Mr. P. Priest.

The club rooms are open on Tuesdays, Thursdays and Fridays from 7 to 10 p.m. and the members hope to start making a receiving set for club use. Demonstations and lectures are being arranged, prominent local amateurs having offered their services. Membership is open to all having reached the age of 18 years. The subscription is 10s. 6d. per annum.

A technical committee is to be appointed who will be in attendance on club nights to give advice and assist members in making sets and improving existing sets. The Secretary would be glad to hear of persons desiring to become members.

**The Durham City and District Wireless Club.**

The meeting held on Friday, September 15th, was devoted chiefly to actual receiving sets. It was decided that the lecture on "Accumulators" by Mr. Geo. Barnard should be held over for a more auspicious occasion, the intention being to hold another open public meeting on somewhat similar lines to the event on Friday, September 1st, as advertised.

The Chairman, Mr. S. Kelly, opened the proceedings by requesting Mr. R. W. Holmes, M.I.M.E., to give a short address, which took the form of some carefully chosen queries, thereby opening quite a lot of discussion. Mr. R. W. Rushworth was then called upon to describe his set. While thoroughly appreciating the benefits of valve reception, he still had a great respect for the much despised crystal, and pointed out the advantages of an ordinary crystal detector. Upon the invitation of the Chairman the Hon. Secretary answered questions spontaneously, during which he revised again the action and function of a condenser, also the spark method of producing high frequency oscillations. He drew and explained simple transmitting circuits upon the blackboard.

A question put to Mr. Barnard by the Rev. Bothamley regarding resistance offered by the insulation of an air gap compared with the inertia of a strong inductive circuit was very ably explained diagrammatically. It was shown and proved conclusively that although the resistance offered by an air gap was much greater than that of a large solenoid, yet this insulation was broken down, causing a spark at the gap terminals owing to the inertia, that is, inductance of the solenoid.

Mr. Barnard was requested to describe types of aerial insulators and lead-in tubes. He handled this controversial subject excellently and exhaustively, during which the types used in the R.A.F. and Navy were described fully. At the close of the question period the Hon. Secretary drew a diagram (his own arrangement) of a two-valve receiver, which was copied by all present.

A hearty vote of thanks was given to the members who had so ably placed their knowledge at the disposal of the meeting.

Several new members were enrolled. The lecture by Capt. Donisthorpe, of the Marconi Co., will undoubtedly prove a great success. No efforts are being spared. Lantern slides and first class apparatus will be used. A special concert is to be transmitted at 9 p.m. from Newcastle for this event.

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# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, anda ddressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

*In view of the serious interference which an oscillating receiver can cause to other receivers in its neighbourhood, it is understood that for broadcast wavelengths certainly, and possibly for all wavelengths, the Postmaster-General will in future allow no type of circuit which is capable of oscillating and so energising the aerial, either directly or through any circuit coupled to it.*

*The necessary consequence of this restriction is that if reaction of the type commonly used in the past is still employed, it must be in such a way that the oscillation point cannot be reached over the wavelength range of the receiver, however tightly the reaction coil is coupled, and with whatever values of filament voltage or plate voltage the set is worked.*

*In order to comply with this requiremenent, it is essential that the reaction coil should be sufficiently loosely coupled to the aerial inductances as not to set up oscillations, or alternatively the reaction might be arranged between the grid and plate circuits of a high frequency amplifier as shown on p. 715 of the issue of September 2nd.*

*We strongly urge readers who are making or using sets of the usual reacting type to either reduce the amount of reaction which they can employ to such an extent that they are perfectly satisfied that the set can never oscillate or to cut out their reaction entirely.*

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**"L. McM." (Maidenhead)** *asks for a diagram for a three-valve circuit to fulfil certain conditions. (2) If honeycomb coils may be used for* **FL.** *(3) Who are* **5 DH** *and* **5 DO.** *(4) If the circuit as suggested is the best way of using three valves.*

(1) Circuit of Fig. 1, page 435, of July 1st issue, is quite a good one. The L.T. battery is not shown, but should be connected straight across any one of the filaments. (2) Certainly. (3) We do not know. These are recently allotted. (4) With interchangeable plug-in transformers this one is the best circuit possible. A potentiometer to the first grid would be of some advantage.

**"M.J.D." Brussels)** *asks (1) What resistance to use with a 4-volt battery and "Ora" valves. (2) What H.T. to use. (3) If 4,000 ohms telephones would be safe under such conditions.*

(1) Very little will be required, say, 2 ohms as a maximum. (2) About 40 volts. (3) Telephones may be put in the H.T. circuit without risk, but it is unwise.

**"E.L.G.R." (New Eltham)** *asks re the super-regenerative circuit mentioned in the July 22nd issue (1) The maximum capacity of the variable condenser across the oscillation circuits. (2) What size basket coils to use for L1, L2 and L3 in the diagram. (3) If basket coils may be used for L4 and L5. (4) What should be the voltage of the grid batteries.*

(1) 0·0005 to 0·001 mfds. (2) L1, 80 turns; L2, 60 turns; L3, 40 turns; all of No. 24 wire with an internal diameter of 2". (3) No, use honeycomb coils of about 1,000 and 1,250 turns. (4) Up to about 12 volts, adjusted by experiment.

**"L.S.D." (Brockley)** *submits a sample of wire, and asks how much would be required to make a 300 metres flat basket coil on the lines described in the June 10th issue.*

The wire submitted is quite unsuitable for the purpose, as both the wire itself and the insulation of it are rather too heavy and stiff. If used, however, about 60 turns should be sufficient.

**"———".**—(1) No, special provision for control of the grid potential of this valve is primarily due to the special grid battery. We should be surprised if the circuit could be made to work with much positive on this grid. (2) Yes, with suitable adjustments of the other voltages. (3) It is undesirable that the frequency of the oscillation should much exceed this value. (4) The valve mentioned is quite good, but almost any good hard receiving valve should be suitable.

**"D.S." (Switzerland)** *asks (1) Whether his set would receive British broadcasting, Paris and Hague concerts. (2) If one detector valve, one H.F. and one L.F. would be a more suitable combination. (3) If a detector valve followed by two L.F. would be much improved by the addition of H.F. valve. (4) What voltages to use with one "R" and two "Ora" valves in this set.*

(1) You omit to give any description of the set, but you are very unlikely to obtain **PCGG** or British broadcasting in Switzerland. Paris should, however, be O.K. with any really good set. (2) This combination is a very good one. (3) Yes. (4) Six volts L.T. and 50 volts H.T. will be sufficient, unless resistance capacity H.F. amplification is used, in which case 70 volts would be desirable.

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**"J.G.C." (Ealing)** *asks with regard to the Reinartz tuner* (1) *If, in order to get the Hague telephony it is better to use an external coil or to increase the internal coils and condensers.* (2) *If the internal coils are increased, whether this will decrease the efficiency on lower wavelengths.* (3) *Dimensions for suitable coils.*

(1) It is immaterial which is done. (2) No, unless any dead-end effects are found, and even this can be got over by the use of two or three dead-end switches to break up the coil. (3) The coil used might be 6" × 4", wound with No. 22 D.W.S.

**"E.C.C." (Weybridge)** *asks for a diagram of a five-valve circuit, arranged to give high frequency amplification, followed by two note magnifiers.*

See diagram, Fig. 1.

**"DATA" (Manchester)** *has a set which is capable of giving radiation, licence for which has been refused by the Postmaster-General. He asks for advice.*

The new Post Office regulations will not permit the use of reaction in any form which might energise the aerial, the object, of course, being to prevent careless operators from spoiling their neighbours pleasure in reception. The only simple way of bringing your single valve set into line with Post Office requirements will be to abandon the use of reaction. In the case of a multivalve set, reaction may be employed, providing that you do not react back nearer to the aerial than the anode circuit of the first valve, and that the degree of coupling between the tuning circuits and any part of the amplifier is manageable.

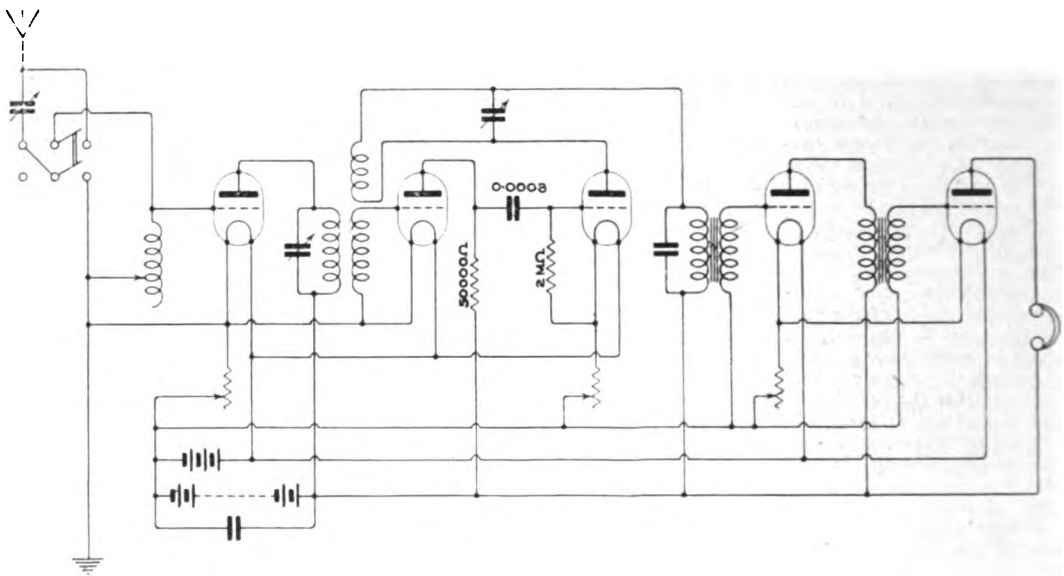


*Fig.* 1.

**"G.O.N." (Liverpool)** *asks* (1) *For an issue of "The Wireless World and Radio Review" containing a description of the code used in the Eiffel Tower meteorological reports, with alterations and additions, if any.* (2) *For dimensions and windings for H.F. transformers for* 400 *metres and* 1,000 *metres.*

(1) This information will be contained in an article shortly to appear in *The Wireless World and Radio Review*, in connection with the series which is now being contributed by Mr. W. G. W. Mitchell. Particulars of the time signal transmissions from Eiffel Tower appear on pages 545/550 of the issue of July 29th. (2) For 400 metres use No. 38 D.W.S., the windings being two layers of 40 turns each on a 1" former with about 5 mils. of paper between the windings. For 1,000 metres the transformers may be similar to the above, but with 85 turns per winding. Some experimental adjustment will probably be necessary to make the optimum values exactly right.

**"R.B." (Carliol)** *sends a circuit for criticism, and asks what stations he may expect to receive on it.*

The circuit shown is quite correct, but note recent remarks on the subject of reaction of the type shown. You might expect to obtain ships off the west coast, and also the proposed broadcasting stations of Manchester and Newcastle, and such land stations as Cullercoats.

**"HETERODYNE" (Shiplake).**—(1) From the symptoms you describe, we should suspect the grid leak, or possibly there is an intermittent action between the grid and filament on one of your valves. Try changing both leak and valve, and also test out all the connections thoroughly. (2) This circuit is not suitable for use for such a range. It is only intended for short wave work, say up to 1,000 metres. (3) Try Stanley's "Wireless Telegraphy," but practice has changed so much in the last few years that there is no really up-to-date work on the subject in existence. (4) This is not necessary unless a grid condenser is used.

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**"W.R.H." (Oldham)** *is constructing a single valve receiver, and asks* (1) *The direction of windings of the inductances; whether the use of ⅛" brass rod as a slider will have a detrimental effect; if the use of dead end switches will permit of reception of short wave telephony, and whether varnishing of inductances will be detrimental by way of increasing the capacity between the turns.* (2) *What tests should be made with a C. Mark II amplifier for the purpose of verifying that it is in good order, and what is the most suitable type of Osram valve for use with such a set.* (3) *Whether the three valves that he already possesses are suitable for use with the C. Mark II amplifier.* (4) *For the name of the manufacturer of a reliable type of H.F. transformer for addition at a later date to the three-valve L.F. set.*

(1) It is difficult to state the direction of the winding of the coils, but all you have to do in the event of the set not functioning correctly is to reverse the wires to the reaction coil. A brass rod slider will have no serious detrimental effect. Ebonite sliders cannot be recommended, unless of substantial dimensions, owing to the tendency ebonite has to become distorted when used for such a purpose. Dead-end switches are to be highly recommended in aerial and reaction circuits for the purpose of efficient reception of short waves. The coils may be shellaced, and should be thoroughly dried out before the varnish is applied. The shellac will slightly increase the self-capacity of the coil, and for this reason you should use double cotton covered wire for winding. (2) If you are in possession of a sensitive galvanometer giving several degrees of deflection per milliampere it will be quite easy for you to make tests on the amplifier. Alternatively telephone receivers may be used in lieu of the galvanometer, but you may have difficulty in distinguishing between the difference in the intensity of the clicks you will get, indicating whether the circuit is complete or broken. By using a 4-volt battery with the meter or telephone receivers in series with it, connect one lead to the H.T. terminal and tap the other on to the valve plate sockets. A deflection or loud clicks will indicate that the circuit is not broken. Tapping round over all other parts of the circuit will indicate whether a contact exists. This confirms the correctness of the primary windings of the transformer. To test the secondaries, join one lead of the L.T. minus terminal and tap out along the grids. The primary of the first transformer should be tested for continuity across terminals L1 and L2, and the secondary of the telephone transformer should be similarly tested by placing the leads across the terminals marked "telephones." "R" type valves are recommended, though the "R4" will give very good results. The voltages as stated, although not agreeing with those given on page 489 of a recent issue, are as in the figures you quote, and derived from measurements taken directly across the valve filaments. To advise an amateur that he is to place 3·8 or 3·5 volts across the filament is of little value, as practically all instruments are fitted with filament resistance, and all he wants to know is the voltage of the battery he must connect to the L.T. terminals. In order that a difference of potential of 4 volts across the filament of an "R" valve may be obtained when working through a resistance, it is frequently necessary to raise the accumulator potential to 6 volts, and particularly is this the case when a number of valves are in parallel across a low capacity accumulator. (3) If the valves you possess are in good condition they should be quite suitable. (4) We recommend you to wind your own transformers to data frequently given in these columns. The design of the transformer required depends upon the circuit in which you propose to connect it. We cannot advise the use of transformers produced by any particular manufacturer.

**"REACTION" (Wood Green).**—The loose coupler described is evidently part of a transmitter, and is not much use for reception, but might give fair results up to perhaps 400 metres. The aerial tuning condenser might be 0·002 mfds. in series with the A.T.I., and the closed circuit condenser could be 0·0007.

**"J.G." (Paisley)** *asks the number of layers to use for duolateral coils, namely No. 28 D.C.C. for an inside diameter of 2" and the winding width 1¼", for tuning from 150 to 25,000 metres with a 0·001 condenser.*

The number of layers required will be one for 150 metres up to 20 for 25,000 metres, with about six intermediate sizes to cover the whole range.

**"G.S." (Marlborough)** *has a heterodyne wavemeter circuit with a range up to 1,500 metres, and asks* (1) *For windings to extend the range in both directions.* (2) *If slab inductances mounted on a former with four split pins for making connections will be satisfactory.* (3) *Why the 12-volt flash lamp battery supplied for H.T. runs down quickly.* (4) *For a semi-aperiodic reactance capacity coupling for use up to 1,200 metres.*

(1) Various instruments of this type are made; you do not give us enough data to discriminate between them. We should advise the use of various honeycomb coils as listed by advertisers. The capacity of the condenser would probably be about 0·0015. This will enable you to choose suitable coils for any range you may require. (2) This mounting will be quite satisfactory, if it is so designed that the relative position of the coils can be kept rigidly fixed. (3) These cells should not run down rapidly unless there is a leak due to faulty insulation. We should advise you to test this out very carefully. (4) If you want any appreciable aperiodicity you should wind with about No. 47 Eureka—say 120 turns with taps at every 30—but we should much prefer No. 34 copper with variable tuning condenser.

**"PILGRIM'S WAY" (Winchester)** *asks for information with regard to certain wireless recording apparatus.*

We have no actual experience of the recorder you mention, but provided that it does not take more than 25 milliamps, the Weston relay should operate it satisfactorily. The signals to be recorded should be L.F. amplified up to the desired strength, preferably by means of your C. Mark III amplifier, in addition to the six-valve receiver, if this is mostly high frequency. After the L.F. amplification, you should again rectify through one or more valves in parallel with a suitable grid potential. The relay should be introduced in the anode circuit of these valves, and the recorder worked through a local battery, generally of about 24 volts, through the armature contacts of the relay.

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**"C.W.T." (Old Swinford)** *is desirous of receiving local amateur telephony, also Croydon, Paris, The Hague and Writtle, and asks* (1) *For a good four-valve circuit.* (2) *The best type of tuner for reception of telephony on* 180/2,600 *metres.* (3) *If it is possible to obtain a transmitting licence for telephony only for the purpose of experimental directional work up to* 20 *miles without the necessity of passing a test in Morse.*

(1) See circuit Fig. 2. This is fitted with an intervalve H.F. transformer which is to be recommended, for although H.F. amplification does not magnify to the same extent as L.F., it will bring in signals which any amount of L.F. amplification would not render audible. As you are only desirous of receiving telephony, which, excepting Paris and Croydon, is always on 350 to 450 metres, one H.F. transformer specially wound for these wavelengths may be incorporated in the set. If you are desirous of tuning in telephony stations on other wavelengths, you must make the transformers interchangable. For 300/450 metres wind 250 turns of No. 40 S.S.C. wire on a 1" ebonite former, cover with a single layer of empire cloth, then wind on another 250 turns in the same direction for secondary; the finishing ends are taken to grid and plate. (2) Making use of the circuit given, you should wind the aerial tuning inductance with 25 turns of No. 22 D.C.C. on a 4" former, and the reaction coil with 40 turns of No. 26 S.S.C. upon a 3" former. (3) It is doubtful whether the P.M.G. would be prepared to grant you a telephony transmitting licence for directional experiments without you first satisfy him that you have a working knowledge of the Morse code. Why not write to the Secretary of the Post Office, stating the circumstances.

**"ROMUS" (Brighton)** *asks how to cut out interference caused by the generator and arc of a near-by picture palace.*

You might try screening the receiving circuits in an iron box; but the real method of cure would be the insertion of large condensers to earth in each lead of the picture-house arc supply. This however, you are not likely to be able to do. If possible, arrange your aerial pointing directly away from the offending picture-house.

**"BERLICK" (Southend)** *asks whether reception on a single valve set would be seriously affected by an aerial running parallel to overhead tram wires* 25′ *to* 30′ *away.*

This depends largely on the tram system. In some places induction under these circumstances would quite prevent reception; in others, some results might be obtained. The induction, of course, will not be quite so serious as that of a multivalve set. We should recommend you to turn the aerial at right angles to the tram wires, if this can possibly be done.

**"KEEN" (West Kirby)** *asks for a diagram of a four-valve receiver, using one H.F., 2 L.F. and one rectifying valve with A.T.I., C.C.I. and separate reactance coil.*

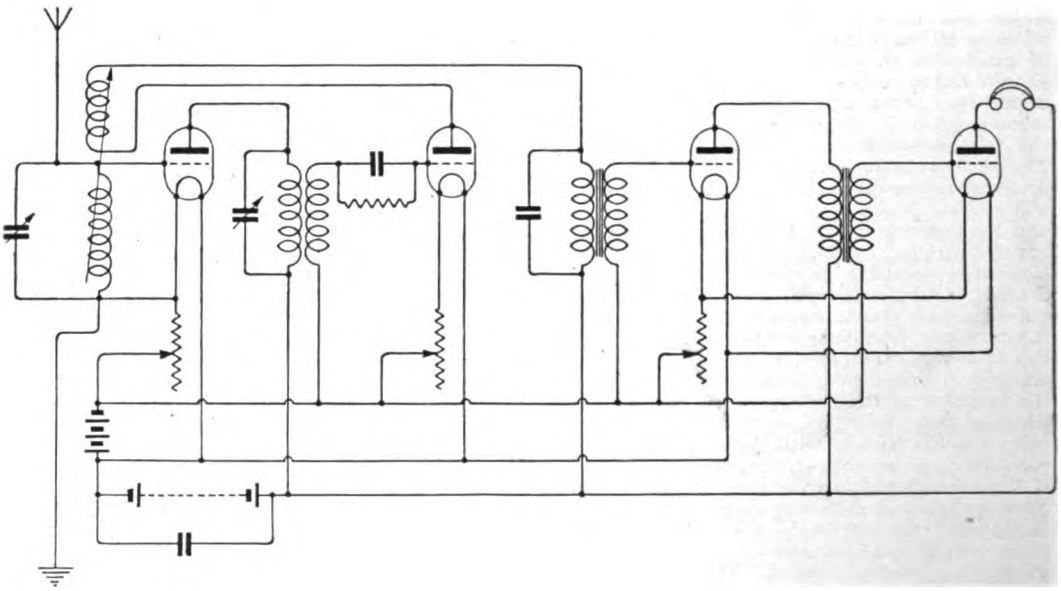

*Fig.* 2.

See diagram (Fig. 2).

**"BEGINNER" (Stanmore)** *encloses a diagram of his set, and asks* (1) *If it is suitable for all telephony.* (2) *For details of construction of transformers and the capacities of the condensers* 1, 2, 3 *and* 4. (3) *For details of construction of A.T.I. and the wavelength of same.* (4) *If a certain coil would be suitable for the L.F. Transformer for his set.*

(1) Yes. (2) (*1*) 0·001 mfds.; (*2*) 0·0005 mfds.; (*3*) 0·0002 mfds.; (*4*) not strictly necessary. If used, should be 0·001 mfds. For transformer data see many recent replies. (3) For the A.T.I. 9″ × 6″ of No. 22. For closed circuit inductance, 7″ × 5″ of No. 26. (4) Core fairly satisfactory if wound with No. 46 S.S.C. Specimen wire quite unsuitable.

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**"H.G.C." (Bristol)** *asks* (1) *Why his single valve set gives no signals, but only a continuous buzzing when the filament is brightened.* (2) *How to make a reactance coil to suit the A.T.I. of this set.*

(1) The circuit diagram is quite correct, but the information does not give us much help to diagnose the trouble. We are inclined, however, to suspect a very faulty grid connection, or a bad grid condenser. It is also possible that the grid of your valve is making intermittent contact with the filament. See if the noises still obtain when the grid condenser is shorted. Your telephones also may have a bad connection. (2) It is unlikely that the reaction will be allowed with a circuit of this type in the future, but if you insist on trying it, 4" × 2" of No. 24 might be a suitable size for your coil. Reduce the number of turns immediately if you find this amount sufficient to make the set oscillate.

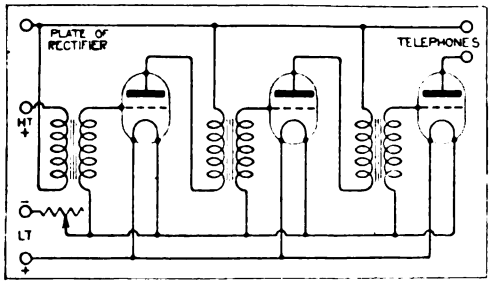


*Fig.* 3.

**"A.E.F." (Finchley)** *asks* (1) *Whether separate H.T. batteries are required for a five-valve set, using some "V.24" and some "Ora" valves.* (2) *For a wiring for a three-valve L.F. panel to comply with certain requirements.* (3) *For a book dealing with certain wireless control problems.*

(1) No. (2) See diagram (Fig. 3). (3) There is no publication which deals at all fully with this subject.

**"L.H." (Bristol)** *asks for data for constructing a tuner for use in aerial reaction circuits, and giving a range of* 150 3,000 *metres with his aerial.*

The coil in the aerial circuit should consist of 7" of winding of No. 26 D.C.C. on a 4½" former, and might be provided with 19 tappings at increasing intervals along the inductances. The reaction coil should consist of 3" of winding of No. 30 S.S.C. on a 3" former, and may have five tappings. You may find it difficult to tune as low as 150 metres with this inductance, in which case you might construct two flat coils specially for short wave work as described on p. 328 of the June 10th issue.

**"M.F." (Folkestone)** *submits a circuit diagram of a two-valve receiver, and asks for criticism and method of adding another valve circuit.*

Your circuit diagram is quite correct. We would suggest that you might extend the tuning range, and also obtain increased signal strength on shorter wavelengths, by arranging to connect the aerial tuning condenser in series or parallel across the A.T.I. This can be done by means of a double coil change-over switch. Both secondary and reaction coils should be tuned with air dielectric variable condensers. When operating several valves from a common H.T. battery, it is advisable not to connect one condenser right across the telephones and H.T. battery, but to use separate condensers, one having the value of about 0·001 mfds. for connection across the telephones and intervalve transformer, and the other of value up to 1 mfd. across the H.T. battery. The value of the grid condenser you show is rather high, and should be of the order of 0·0002 to 0·0003 mfds. There is no difficulty in adding a note magnifier by connecting an intervalve transformer in place of the telephone receivers, and taking the leads to grid and L.T. minus of the added valve, the telephones being connected between its plate and the H.T. plus. A wiring diagram making use of the circuits, very similar to the one you already have, is shown on page 37 of the April 8th issue.

**"F.L." (Ilkley)** *is making use of a six-valve receiver, and has difficulty in the reception of Paris telephony, is unable to receive* **PCGG,** *shipping signals only very occasionally, whilst amateur telephony cannot be heard, and asks for criticism of his circuit.*

Your circuit is in every way correct, and the use of tuning condensers across the secondary and reaction inductances is to be recommended. The condensers bridging the primaries of the H.F. transformers would certainly facilitate their action on the particular wavelength for which they are required. You might try connecting the reaction coil in series with the plate circuit of the third valve instead of with that of the first valve. You might try also connecting the leads from the transformer secondaries to the L.T. minus instead of L.T. plus as shown. Unfortunately you do not give the dimensions of your tuning coils. For the reception of short wave telephony we recommend you to construct some special coils to the design given on page 328 of June 10th issue. The detector valve should be one specially designed to give good rectification, such as an "R.4b" or "Q," and you should experiment with several grid condensers and leaks in order to get the grid potential correct. The use of a potentiometer to control the grid potential of the H.F. valves, and another to control the detector valve, may be found helpful.

**"A.R.C.J." (Acton)** *has a Mark I C.W. set arranged for telephone transmission and reception, and asks* (1) *For method of adding one H.F. and two L.F. amplifiers to same, and* (2) *Whether an inductance coupled to the old circuit with a microphone connected across its ends is a satisfactory arrangment for telephony.*

(1) We would recommend you to use an entirely separate circuit for reception, leaving your present set as it stands for use as a transmitter. A valve designed for transmitting purposes will not act as an efficient detector, as will be required for bringing in telephony. This journal is full of circuits comprising a great variety of H.F. and L.F. amplifiers. (2) This is quite a satisfactory arrangement for small power, though the extent of coupling between the two coils is critical.

**"G.C.S." (Palmer's Green)** *asks* (1) *For a circuit to use certain gear.* (2) *How inductive reactance is obtained with slab inductances.* (3) *If* 6 *and* 60 *volts are too high for "Ora" valves.*

(1) See Fig. 1, page 465, July 8th issue, and many similar circuits. (2) By bringing the coils close

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together in almost any convenient way. (3) A filament resistance of say 5 ohms will be necessary. H.T. battery voltage is high but will do no harm.

**"C.R." (North Devon)** *is constructing a five-valve receiver, and wishes to know the number of plates required for the construction of the various condensers.*

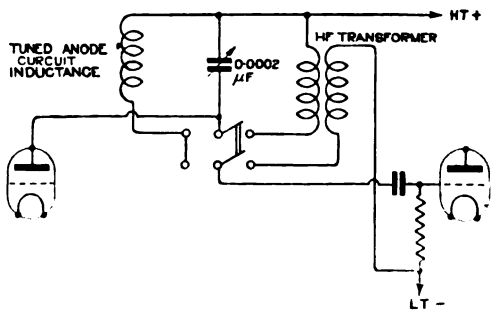
The aerial tuning condenser should have a capacity of between 0·001 and 0·0015 mfds. If the space between the plates is 5/64" and the plates have a thickness of 20 gauge S.W.G., then 31 fixed and 30 movable plates will give a capacity of approximately 0·0014 mfds. The grid condenser should have a value of approximately 0·0003 mfds, and should consist of three plates, with an overlap of 1"×⅜" separated with mica two thousandths of an inch in thickness. The middle plate will form one terminal of the condenser and the remaining the other. The condenser that bridges the primary of the first L.F. transformer should have a value of about 0·002 mfds. and should consist of 15 plates of similar dimensions to those of the grid condenser. The condenser that bridges the H.T. battery may have a value up to 0·5 mfd., and should consist of about 21 tin foil plates 2½"×4" with waxed paper dielectric.

**"W.McN." (Stamford)** *refers to the Armstrong super-regenerative circuit, and asks* (1) *Whether honeycomb or duolateral coils are suitable for the inductances.* (2) *What make of valve is recommended for use in the circuit.* (3) *The values of the variable condensers across the inductances and the fixed condenser across the telephones.* (4) *Whether a Brown loud speaker may be interchanged with head telephones, retaining the same condenser.*

(1) Coils of this type may be used. The inductances L1, L2 and L3 are of a suitable value for bringing in the required signals, and should preferably all be bridged with variable condensers. L4 and L5 are of large value such as will set up oscillations on wavelengths just above audible frequency. (2) This circuit was originally designed and recommended for use with special varieties of American valves, but it will work quite well with British valves of the usual "R" type. A "Q" or "R.4b" would give quite good results in the first valve circuit, whilst a "V24" might be connected in the oscillator circuit. (3) Maximum 0·0005 mfds. Telephone condenser 0·001 to 0·002 mfds. (4) The telephones may be interchanged with a Brown loud speaker, provided the loud speaker is of high resistance, though we do not think that by using this circuit you will obtain sufficient amplification for operating the loud speaker on telephony.

**"T.T.C." (Southgate)** *refers to the circuit given on page 573 of July 29th issue, and asks for sizes of coils, condensers, etc.*

Sizes of inductances depends entirely upon the range of wavelength to which it is desired to tune. We would recommend you to use interchangeable coils fitted with plugs and sockets. Within the aerial circuit may be a single coil arranged to plug into a socket fixed to the panel of the receiver, whilst the three in the second valve circuit may be the usual variety of three-coil holder to take the coil referred to. The condenser in the aerial circuit should be of the air dielectric type and have a maximum capacity of 0·001/0·0015 mfds., and should be arranged for connection either in series or parallel with the inductances. When tuning to very short wavelengths, such as are used for telephony, connect your aerial tuning condenser in series with the inductance, and in addition another small condenser having a value of about 0·0001 may be connected between the variable condenser and inductance. The condenser in the plate circuit of the first valve should have a maximum value of 0·0005 mfds. Similar condensers may with advantage be connected across the inductance of the grid circuit of the second valve, and also the plate circuit inductance.




*Switching arrangement for interchanging tuned anode inductance and transformer in H.F. amplifying circuit.*

**"R.E." (West Kensington)** *refers to the expression "loud speaker," and asks for details regarding the construction of such apparatus, and how it differs materially from a receiver with a trumpet attachment.* (2) *Whether it is practicable to use a frame aerial with six or more valve amplifier for the reception of broadcast telephony.*

(1) Several varieties of loud speakers consist merely of a receiver earpiece with a trumpet attachment, and if wound to a low resistance a step-down transformer is required when operated from the plate circuit of an amplifier valve. If you propose to construct one of these instruments, we would suggest that you take an ordinary telephone earpiece, say of the "Brown" type, with adjustable armature, and fit to it a trumpet of a shape which you may find by experiment will not produce too much distortion. The trumpet must be an airtight fit over the diaphragm and the column of air between the base of the trumpet and the diaphragm must be as short as possible. (2) Until broadcasting stations are established, it is difficult to say the range of reception on various types of apparatus, but with present transmission from Marconi House, we think you should have no difficulty in receiving them satisfactorily on a frame aerial, using the 6-valve amplifier as you suggest. This amplifier should consist of three high frequency valves, detector, and two note magnifiers, and the frame should, if possible, have sides of at least 4 ft. We recommend strongly, however, the use of a small indoor aerial run across the room, and we think that with so many valves such an aerial would give results superior to the frame. However, it is just a matter of simple experiment in your locality. Circuits comprising H.F. and L.F. amplifiers are to be found in nearly every issue of this journal: see pp. 570 and 572 of July 29th issue, also p. 607

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of August 5th issue. A variable condenser is connected across the ends of the frame, and leads taken to the grid and L.T. minus of the potentiometer.

**"A.M." (Plaistow)** *has constructed the crystal receiver with flat coils as described in the article on Experimental Station Design in June 10th issue, and is able to receive* **2 LO**, *and, weakly,* **2 MT**, *and asks if there is any error in this arrangement.*

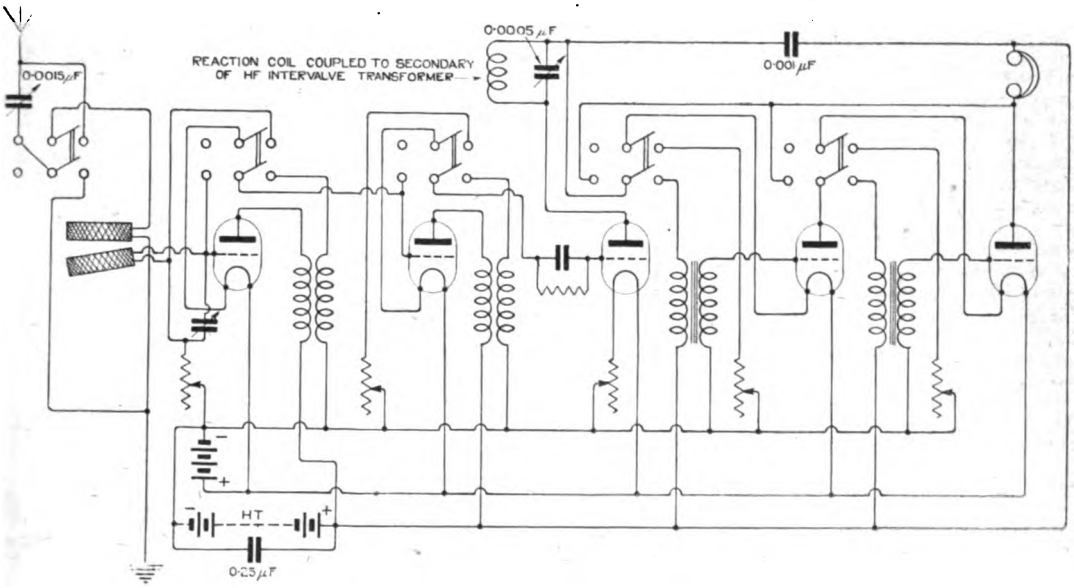
This is a very simple crystal receiver, which embodies neither secondary circuit nor aerial condenser, and was designed for the reception of telephony broadcasted on high power, such as it is hoped will soon be available, and for which purpose it would be quite satisfactory. The fact that you are receiving the telephony transmitted from Writtle on low power indicates that your set is working very well indeed, and when a service is organised making use of greater power, your present apparatus will prove quite useful for its reception. These articles have now described the construction of a single valve panel. If the range is as required, you might follow up your constructional work, and undertake to make all the apparatus described.

**"S.T.N." (Windsor)** *submits a circuit and asks* (1) *For criticism.* (2) *For the capacities of the various condensers.* (3) *Whether a condenser is required across the secondary of a high frequency intervalve transformer and* (4) *Types of valves most suited for use in this circuit.*

(1) The circuit is quite satisfactory, but you might arrange to connect your aerial tuning condenser either in series or parallel across the aerial tuning inductance. A condenser bridged across the reaction coil would facilitate fine tuning on short wavelengths. You do not describe the construction of the intervalve oscillation transformer, but if the two windings are fairly tightly coupled, you will only need to bridge the primary, that is, the one in the plate circuit, with a variable condenser. (2) 1.—0·001/0·0015 mfds. 2.—0·0005. 3.—0·0002/0·0003. 4.—0·001/0·002. 5.—0·01 to 1 mfd. 6.—0·0001 mfd. All of the variable condensers should have air dielectric. (3) A tuning condenser is very helpful across the primary of the transformer. (4) You are quite correct in your suggestions as to types of valves. Use "R," "V24" or "QX" for the first, "R 4b" or "Q" for the second, and for the third "R."

**"BROWNING" (Eastbourne)** *asks for numbers of French patents covering the construction and main features of the receiving valve.*

It is regretted that we cannot undertake to give information relating to patents. The information you require can be best obtained by searching the files of the Patent Office, or by consulting a Patent Agent who specialises in this class of work.




SWITCHING OF VALVE CIRCUITS.

*Above is given a circuit diagram showing the method of switching in and out of circuit, high and low frequency amplifying valves. It gives the principle by which the number of valves in circuit is varied, and can easily be applied to circuits comprising any number of valves. The reaction coil can be coupled either to one of the H.F. transformers or to the closed circuit inductance.*

**"H.W." (Bolton)** *is constructing a five-valve amplifier and asks* (1) *For criticism of the circuit he proposes to use.* (2) *Whether it is suitable for reception of* **2 MT, PCGG** *and* **FL**, *and* (3) *If potentiometer control is recommended.*

(1) The circuit is quite a good one, but the wiring up of the jacks and the high frequency circuits will require considerable care and jacks of the usual telephone type should not be used. A special type was advertised on the back cover of the July 22nd issue, and you should write to the manufacturers, asking them for jacks designed to suit your purpose, having very low capacity between the springs. The intervalve transformers must

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be carefully made in order that those that are used together may cover identical wavelength ranges. (2) Yes. (3) Recommended.

**"H.M." (Manchester)** *is constructing a low power transmitting set and asks* (1) *Size of aerial inductance for use on wavelength of* 440 *metres with an aerial* 100′ *long and* 30′ *high.* (2) *Size of aerial tuning condenser.* (3) *Dimensions of grid circuit inductance.* (4) *Whether speech could be transmitted successfully with a circuit designed to transmit tonic train.*

(1) 25 turns on a 4″ ebonite former. Use No. 20 D.C.C. for winding, or better still, special flat strip wire may be used with a winding of thin string between each successive turn. (2) Variable, with a minimum value of about 0·001 mfds. (3) 30 turns of No. 24 D.S.C. on a 2″ former. You may find it helpful to bridge this inductance with a small tuning condenser. The extent of coupling between the grid and aerial inductance will depend upon the amount of power used, and if the size for this coil is 2″ in diameter, it would provide ample coupling when used on 10 watts. For lower powers you will need to increase the diameter and make the grid circuit inductance slide inside the aerial inductance. (4) Speech cannot be transmitted from an interrupted source of H.T. unless the aperiodicity is fairly high and a rectifying valve with chokes and condensers is connected intermediately between the source of supply and the transmitting valve.

**"W.S." (Victoria)** *refers to the reply given to* **"J.R.C." (Kilburn)** *on page* 527 *of the July* 27*th issue, and asks* (1) *Whether the secondary can be arranged at right angles to the A.T.I., inside which a coil is arranged to provide coupling, and also whether this coil should be made to swing through* 60 *degrees; whether a reaction coil wound on a spherical former and made to rotate inside the secondary would be satisfactory, or should the reaction coil be cylindrical and slide inside the secondary.* (2) *Whether we recommend the use of change-over switch for providing "tune" and "stand by."* (3) *Whether in making use of a three-valve low frequency amplifier he might break the plate circuit of his first valve and connect in a reaction coil.* (4) *Whether the set made up as indicated by his questions would be efficient for the reception of weak telephony on* 1,000 *metres.*

(1) The aerial with closed circuit arrangement would be satisfactory. The coil that provides coupling between primary and secondary should be made a close fit and arranged to slide away from the aerial winding. If pivoted, it may not provide sufficient coupling, but it should be arranged to move through 90 degrees. A spherical reaction coil may not provide sufficient range, and also may perhaps not provide sufficient coupling on long wavelengths, and that also should be arranged to slide inside the aerial coil. In the diagram referred to, it was intended that a three-coil holder should be used with a set of interchangeable inductances. (2) Yes, the use of such a switch would be found very convenient. (3) It is better to break the plate circuit between the plate and the lead to the intervalve transformer. The primary of the transformer must also be abridged with a fixed condenser of value of about 0·001 mfds. You may certainly connect several stages of high frequency amplification in front of the first valve of the amplifier which functions as a rectifier. (4) Yes; but we would recommend you to adopt coils of the type proposed in (1).

**"H.E.S." (N.16)** *has access to a battery of Leclanche cells and asks for an opinion on superiority of such a battery over the usual type*

Such a battery is very bulky, and requires a good deal of attention as to maintenance, particularly with regard to corrosion, creeping and drying up of electrolyte, and for a single valve receiver you would be well advised to use the more convenient small type built up in 15 volt units. On a single valve receiver in frequent use, the usual small type of H.T. battery would have a life of over 12 months, and requires no attention. If, however you are using a receiver with three or more valves the use of the Leclanche battery may be found more economical and worth while, owing to the heavier load taken from it. When using such a battery for high tension supply, you must take good care that all cells are well insulated from one another and from earth. You might arrange them in sections in boxes standing on china insulators. Such a battery is practically useless as a source of filament current, unless, of course, you are prepared to connect it up in a number of parallel groups, such as connecting five cells in series, and all of these groups of five in parallel with one another. Even with this arrangement the battery would require considerable attention, and would not be as convenient as an accumulator.

**"O.G." (Brierfield)** *submits a diagram of his set, comprising one H.F. (tuned anode) detector and L.F., with which he is not obtaining very good results, and asks for criticism.*

Your circuit is quite correct, and should give satisfactory results, and the fault must lie in constructional details. If you wish to make a change in the circuit, however, you might connect your reaction coil between the low frequency transformer and the plate of the second valve, instead of coupling the tuned anode coil to the aerial circuit. It is essential to bridge the tuned anode coil with a variable condenser, and with the reaction arrangement proposed you will find it helpful to connect the condenser across the coil. Valves specially designed to function as H.F. amplifier, detector and low frequency amplifier will considerably improve results. The value of the grid condenser is important, and you might reduce it to a value of about 0·0003 mfds., with a leak of 2 megohms.

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